



# WESTERN AUSTRALIAN Mineral and Petroleum STATISTICS DIGEST

## 2006-07



Department of  
**Industry and Resources**

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# WELCOME TO THE DEPARTMENT OF INDUSTRY AND RESOURCES' 2006-07 STATISTICS DIGEST.

This publication contains the most comprehensive statistical information available on the Western Australian minerals and petroleum industry.

The statistics in this Digest show that in 2006-07 the value of sales by the State's minerals and petroleum sector set a new record, rising by 25 per cent to reach \$53.4 billion. This follows a decade of average annual growth of twelve per cent.

This record result was driven by strong overseas demand for our resources and rising commodity prices. Despite the robust nature of the industry, the year produced many challenges and the impressive result was achieved against a background of a strengthening Australian dollar, adverse weather conditions, skills shortages and mining equipment supply constraints.

The minerals and petroleum sector continues to remain the engine of the State's economy accounting for around 30 per cent of Gross State Product, 88 per cent of its export income and around one-sixth of its employment.

Western Australia is one of the great mineral provinces of the world. It hosts an impressive 544 commercial mineral projects, embracing 1030 operating mine sites which produce over 50 different minerals. In 2006-07, there were also 62 operating oil and gas fields.

With a broad range of expansions and new developments underway to address continuing strong demand, it is expected that growth of the minerals and petroleum sector will continue in 2007-08.

It is not possible to prepare such a comprehensive range of information without assistance from outside the Department. I would like to thank the various resource companies, Australian Bureau of Agricultural and Resource Economics (ABARE), Australian Bureau of Statistics (ABS) and the Western Australian Department of Treasury and Finance for their cooperation and help during the preparation of this Digest.

Jim Limerick  
Director General



# 1. EXPLORATION AND INVESTMENT

## 1.1 PETROLEUM EXPLORATION

In 2006–07, total petroleum exploration expenditure in Australia grew by 76 per cent to \$2225.5 million. The majority of this expenditure, 78 per cent, was spent offshore. ABS statistics also indicate that around three-quarters of this expenditure was on areas outside of production leases.

Expenditure on petroleum exploration in Western Australia during the same period grew by nearly 150 per cent to \$1481 million. This represented 67 per cent of the national total, an increase on 2004–05 when the share was 47 per cent. Listed below is a breakdown of the various states' share of petroleum exploration expenditure for 2006–07:

- Western Australia 67%
- Northern Territory 13%
- Queensland 9%
- South Australia 7%
- Victoria 3%
- New South Wales and Tasmania 1%

Significantly, 2006–07 has seen a large increase in new companies applying to explore in Western Australia. The high number of bids and the level of proposed investment, demonstrates the great interest in Western Australia.

Earlier in 2007, an unprecedented \$841 million was announced to be spent on new exploration work programs in the State's far north, including the largest single work commitment in Western Australia's petroleum exploration history. In July 2007, the results of a second bidding round were announced with exploration programs in new offshore permits worth more than \$560 million.

However, most petroleum exploration, investment and development is taking place in offshore areas of the State, from which Western Australia receives no fiscal benefit with Government revenues accruing to the Commonwealth. Conversely, the majority of Western Australia's onshore areas are under-explored and relatively untouched, despite the potential for huge resources to be found.

It is therefore significant for Western Australia that commitments for exploration this year have not been restricted to offshore areas. Albeit at a small level relative to offshore, it is heartening to see onshore exploration receiving an overdue boost with new interest in the Canning Basin.

Further information on petroleum exploration activity in Western Australia can be found in the Department of Industry and Resources' publication "Petroleum in Western Australia". This publication contains a comprehensive overview of petroleum exploration activities in this State together with details on the award of petroleum exploration permits.

## 1.2 MINERAL EXPLORATION

Mineral exploration in Western Australia expanded significantly compared to 2005–06 by \$249 million or 42 per cent in 2006–07 to reach \$839.2 million. Of these funds, 60 per cent were spent on existing deposits with the remaining 40 per cent spent on new ground.

Although the current boom in mineral exploration in Western Australia is welcome, in inflation-adjusted terms, expenditure has not quite reached the level of the previous boom in 1996–07.

Western Australia attracted 49 per cent of the total Australian mineral exploration budget of \$1714.6 million in 2006–07. This percentage share is still short of the highs of the last boom during the mid- to late-90's when the State share was around 62 per cent. Nonetheless, it demonstrates the attractive mineral potential the State offers to explorers compared with other states within Australia. The following list shows the order of state share:

- Western Australia 49%
- Queensland 16%
- South Australia 15%
- New South Wales 8%
- Victoria 5%
- Northern Territory 6%
- Tasmania 1%

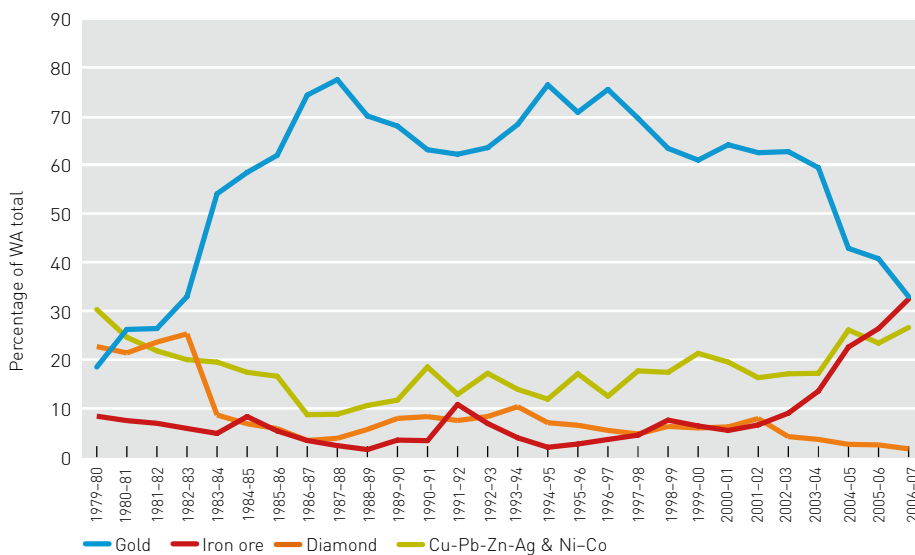


Figure 1 | Exploration Expenditure in WA (% of total by commodity)

National expenditure in 2006–07 increased 38 per cent (\$475.9 million) with Western Australia's share of this increase a little over 52 per cent.

Nationally the number of metres drilled during 2006–07 increased some 24 per cent over 2005–06 to 8455 metres. A total of 62 per cent was drilled on existing deposits whilst the remaining 38 per cent was drilled on new ground.

For nearly thirty years gold has accounted for the majority of exploration expenditure in Western Australia accounting for around 65 per cent annually. In 2004 gold's share of exploration expenditure started to drop off and is now around half that over the previous three decades and in 2006–07 accounted for just 33 per cent of the

State's exploration expenditure. Nevertheless, gold did increase some 15 per cent over the 2005–06 year to \$276.5 million.

Around the same time in 2004 iron ore started to increase expenditure in response to pressure from the marketplace for additional supply. With record prices being achieved and a whole range of Western Australian projects attracting financial investment from iron ore buyers, exploration expenditure started to rise. On average the iron ore share of the State's exploration expenditure has been around four per cent, however in 2006–07 it reached a record 32 per cent or \$272.2 million, putting it on a par with gold for the first time.

Nickel has maintained an average share of around 15 per cent over the past fifteen years and in 2006–07 reached 21 per cent or \$158.2 million. Constrained supply and strong demand has pushed nickel prices to record levels and has been the driving force behind increased nickel exploration.

### 1.3 INVESTMENT

ABS private new capital expenditure statistics show a very significant rise in the value of new capital expenditure over the past three years increasing some 115 per cent. In 2006–07 the amount of capital expenditure on mining in Western Australia alone amounted to \$13.5 billion, which was a 26 per cent increase compared to the previous financial year. This also represented 69 per cent of Western Australia's total (\$19.7 billion) new capital expenditure in 2006–07.

Total national mining investment in 2006–07 amounted to \$22.1 billion, an increase of 19 per cent compared to the previous financial year. In 2006–07, Western Australia accounted for around 61 per cent of the total national mining investment.

It is important to note that the figures reported above do not capture all mining investment as the ABS uses classifications specified in the 1993 edition of the Australian and New Zealand Standard Industrial Classification (ANZSIC) (ABS catalogue number 1292.0). Accordingly, mining is broadly defined as the extraction of minerals occurring naturally as solids such as coal and ores, liquids such as crude petroleum and natural gas. Downstream mining activities such as smelting of minerals or ores (other than preliminary smelting of gold) or refining are classified as manufacturing activities under the ANZSIC. Products such as coke and alumina are also included in the ANZSIC manufacturing category.

The Department's databases indicate that there are around \$95 billion worth of potential resource projects currently under construction or consideration for development in Western Australia. This includes large projects such as, for example, the Fortescue Metals mine, rail and port development, Hope Downs iron ore mine and the Ravensthorpe nickel mine and processing plant. A significant number of upstream petroleum projects are either underway or planned for the State over the next few years, totalling around \$50 billion. These projects include committed expenditure on Woodside's expansion of its North West Shelf (NWS) upstream facilities, its Enfield, Stybarrow, Angel and Vincent oil developments plus its Browse and Pluto Liquefied Natural Gas (LNG) projects.

Taking into consideration the total potential completed investment value of mining and petroleum projects either underway or planned for the State over the next few years (around \$95 billion), associated with this is over 38 000 additional construction jobs and around 10 000 full-time jobs.

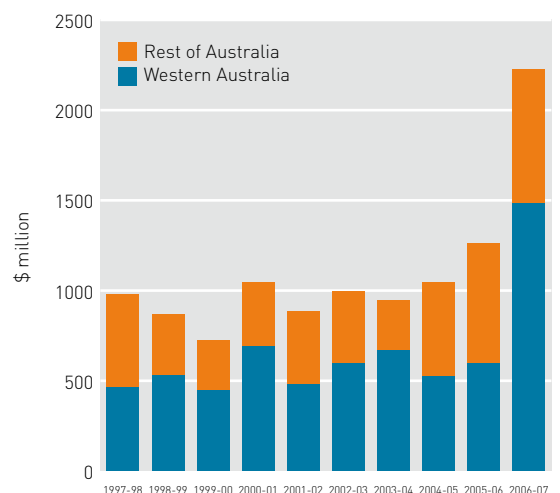


Figure 2 | **Petroleum Exploration Expenditure**  
Source: ABS

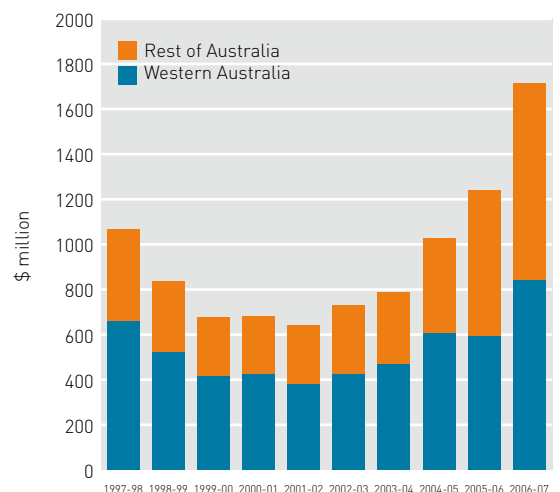


Figure 3 | **Mineral Exploration Expenditure**  
Source: ABS

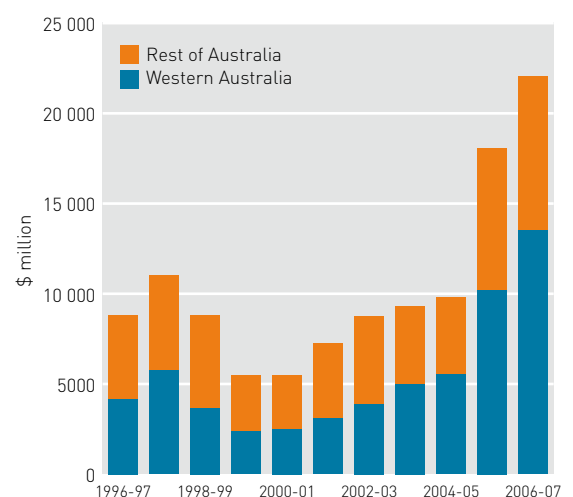


Figure 4 | **Mining Investment** Source: ABS

## 2. MINERALS AND PETROLEUM INDUSTRY 2006–07 REVIEW

### 2.1 OVERVIEW

In 2006–07 the estimated value of Western Australia's mineral and petroleum industry reached \$53.4 billion. This represented a 25 per cent (\$10.6 billion) increase compared to the previous financial year. The record result was achieved through strong overseas demand (particularly from China) for mineral and petroleum commodities, pushing resource prices well above forecast levels. When analysing this outcome it needs to be considered in the context of a 5.2 per cent strengthening of the Australian dollar against the US dollar, adverse weather conditions in the first quarter of 2007, plus ongoing difficulties with equipment supplies and skills shortages.

Accounting for most of the increase in value was nickel, iron ore and petroleum. These three industries accounted for around 75 per cent of the total value of \$53.4 billion for 2006–07. Almost level-pegging for first place are petroleum and iron ore at around 30 per cent each with nickel at 15 per cent of the overall value. Not all commodities recorded increased output levels, notably nickel, gold, diamonds and coal.

Petroleum is the largest resource sector by value and an increase in sales of \$1.6 billion saw it reach a record level of \$16.4 billion. This was chiefly due to continued high world oil prices and a sharp increase in crude oil production.

Closely behind petroleum is iron ore. This giant of the minerals industry sold a record 258 million tonnes in 2006–07, valued at \$15.8 billion, an increase of six per cent and 24 per cent respectively. With mine and port expansions, proposed new developments and anticipated continued strong demand, it is expected that this sector will continue its record-breaking run well beyond 2007–08.

By far the most outstanding performer in dollar terms is nickel, valued at \$8 billion, increasing an astounding 110 per cent (\$4.2 billion) over the previous financial year. Sales quantities actually dropped five per cent from 2005–06 to 174 thousand tonnes.

Next in order of value to the State is alumina, with a sales value of \$4.8 billion (an increase of some 17 per cent compared to the previous period), followed closely by gold at \$4.1 billion, up 10 per cent.

The base metals sector also performed particularly strongly with high prices helping to record a 71 per cent increase and reach a total of \$1.7 billion worth of sales. Diamonds sales were down, recording a 3 per cent decrease, to 4.8 million carats and salt sales of an estimated \$228 million, were a little over 7 per cent down in volume terms compared to the previous period.

An average of 5.2 per cent appreciation in the Australian dollar against the US dollar during the 12-month period to the end of 2006–07 had a small influence on the outcome. The major factor contributing to the increase in value of the Western Australian resources sector was high commodity prices. The following table illustrates the magnitude of price increases during 2006–07 (average price in 2006–07 compared with equivalent in 2005–06).

	US\$ TERMS		A\$ TERMS	
NICKEL	UP	146%	UP	132%
ZINC	UP	73%	UP	65%
LEAD	UP	59%	UP	50%
COBALT AND TIN	UP	55%	UP	46%
COPPER	UP	40%	UP	33%
GOLD	UP	21%	UP	15%
IRON ORE	UP	16%	UP	11%
ALUMINA	UP	16%	UP	10%
CRUDE OIL	UP	2%	DOWN	3%

It is expected that the strong demand for the State's resources by Western Australia's trading partners will continue in 2007–08.

Some additional salient indicators of Western Australia's significance in the national resource industry are that the State accounts for:

- approximately 50 per cent of Australia's total value of mineral and petroleum sales (based on DoIR and ABARE published data);
- 69 per cent of Australia's oil and condensate production (based on published data by ABARE); and
- 38 per cent of Australia's total merchandise exports in 2006–07 (sourced from ABS).

The magnitude of the State's mining developments is demonstrated in the latest Australian Bureau of Statistics (ABS) investment figures for 2006–07. This data shows that Western Australia's share of national mining capital expenditure rose from 54 per cent (\$10.7 billion) in 2005–06 to 61 per cent (\$13.5 billion), a 26 per cent increase for the year. National mining capital expenditure rose only 19 per cent from the previous year, indicating around 80 per cent of this increase was invested in Western Australia.

Western Australia topped all the other States contributing a little under 38 per cent (\$60.5 billion) towards the total Australian merchandise exports for 2006–07, an increase of five per cent from the previous year. Queensland followed with 22 per cent, then New South Wales with 18 per cent and Victoria contributing about 12 per cent.

The Western Australian mining and petroleum sectors contributed a massive 88 per cent (\$54.07 billion) toward the State's merchandise exports in 2006–07 which highlights the importance these sectors have not only to the State's economy, but that of Australia.



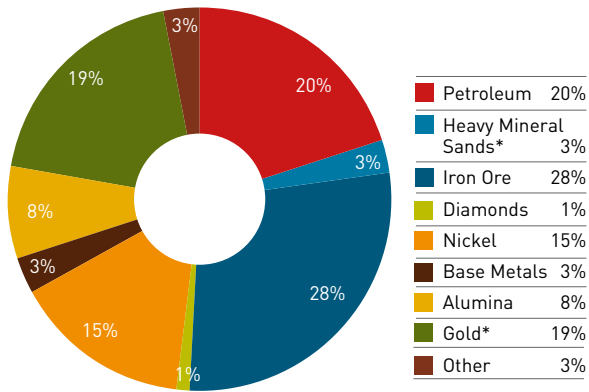


Figure 5 | **Western Australian Mineral and Petroleum Exports 2006-07**  
**Total Value \$54.07 billion** Source: DoIR

\* Includes \$6.33 billion of gold and \$70 million of heavy mineral sands refined/processed and exported from Western Australia, but produced from mining operations in other States, Territories and overseas and \$407 million of TiO<sub>2</sub> exports

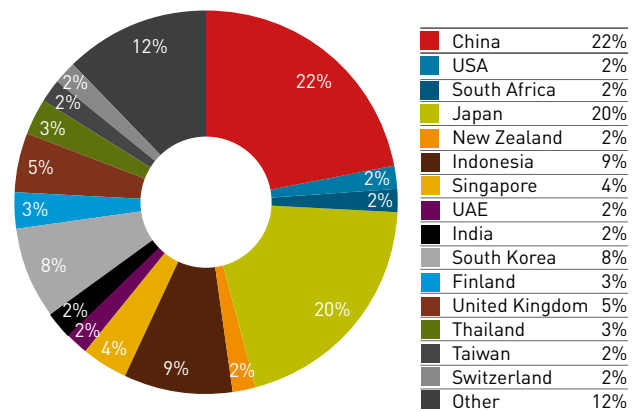


Figure 6 | **Western Australian Merchandise Exports 2006-07**  
**\$60.52 billion** Source: ABS

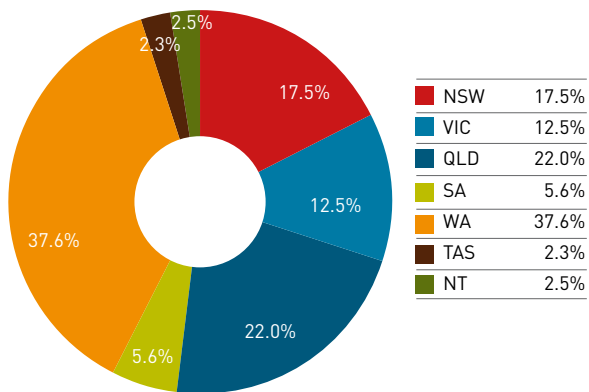


Figure 7 | **Australian Merchandise Exports**  
**Total Value \$160.8 billion** Source: ABS

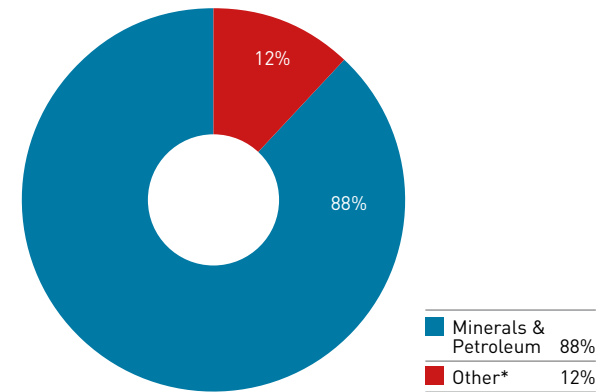


Figure 8 | **Western Australian Merchandise Exports 2006-07**  
**\$60.52 billion** Source: DoIR

\* Other includes wheat, wool, live animals, seafood, meat, pearls and other agricultural and manufactured items.

### TENEMENTS IN FORCE 1978 ACT

	2000-01		2001-02		2002-03		2003-04		2004-05		2005-06		2006-07	
	Number	000 ha	Number	000 ha	Number	000 ha	Number	000 ha	Number	000 ha	Number	000 ha	Number	000 ha
Prospecting Licences	5,512	711	4,964	635	4,566	575	4,561	568	4,665	586	5,056	638	5,376	682
Exploration Licences	3,162	18,152	2,899	18,556	2,855	21,123	2,917	20,896	3,066	22,215	3,966	30,822	4,766	40,031
Mining Leases	4,841	1,803	4,820	1,774	4,770	1,762	4,713	1,716	5,172	1,805	5,118	1,806	5,090	1,824
Other	3,625	2,840	3,618	3,002	3,629	3,299	3,590	3,115	3,258	2,982	3,432	3,037	3,629	3,248
Mineral Claims & Other 1904 Act	186	21	186	22	186	22	186	22	186	22	186	21	186	21
<b>Total</b>	<b>17,326</b>	<b>23,829</b>	<b>16,487</b>	<b>23,988</b>	<b>16,006</b>	<b>26,781</b>	<b>15,967</b>	<b>26,317</b>	<b>16,347</b>	<b>27,610</b>	<b>17,758</b>	<b>36,324</b>	<b>19,047</b>	<b>45,806</b>

Source: DoIR

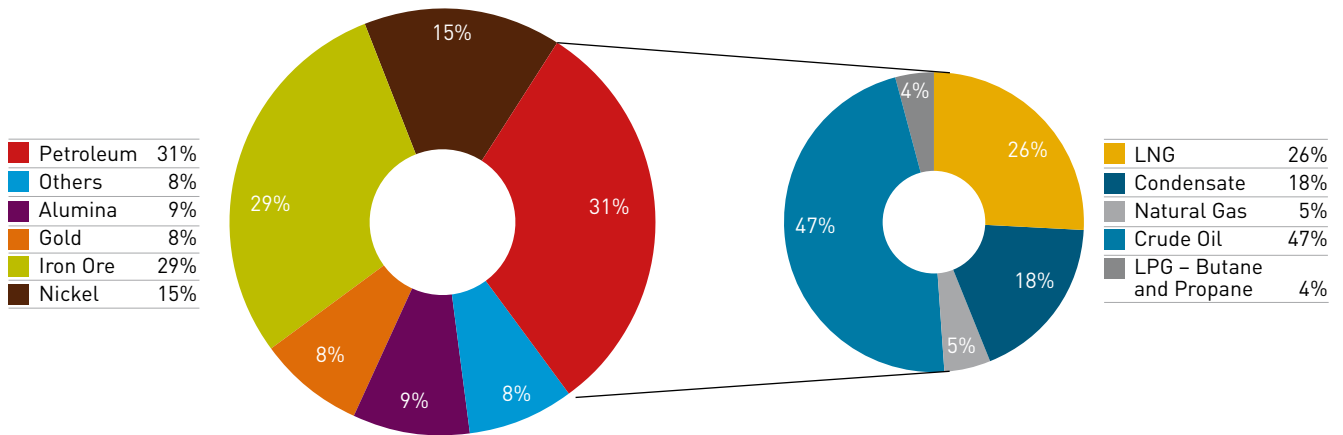


Figure 9 | Value by Commodity 2006-07 \$53.4 billion Source: DoIR

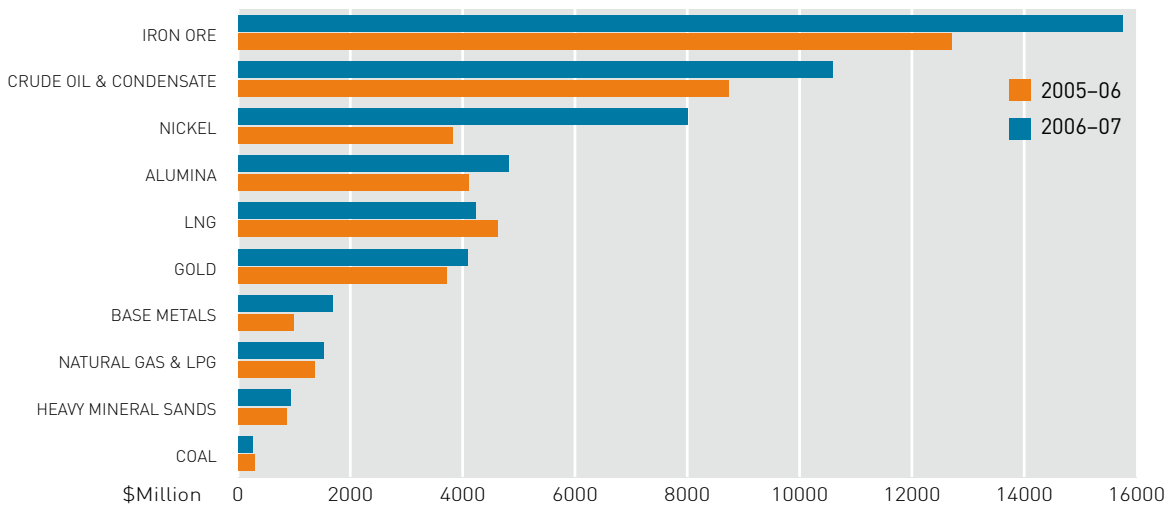


Figure 10 | Major Commodities by Value Source: DoIR

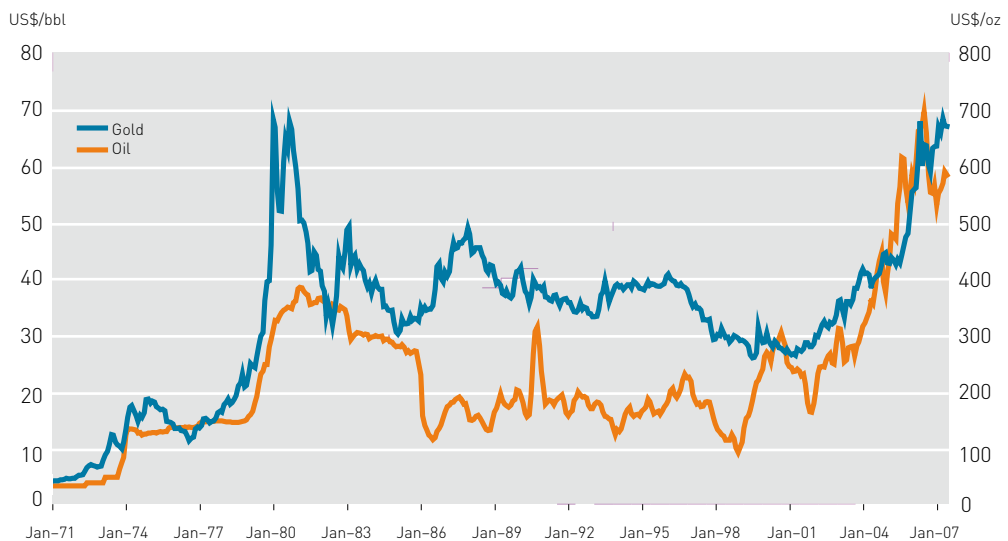


Figure 11 | Historic Oil and Gold Prices in US Dollars Source: US Department of Energy and LME London PM fix

## HIGHLIGHTS IN 2006–07

After the petroleum sector, in terms of minerals, iron ore is now the largest individual mineral sector by value, accounting for 30 per cent of the value of resources output for 2006–07. On the back of a 19 per cent increase in prices effective April 2006 and strong demand, particularly from China, iron ore reached a record sales value of \$15.8 billion in sales, based on 258 million tonnes of ore. A further price increase, effective April 2007 of some 9.5 per cent further added to iron ore’s record.

The Tapis oil price peaked in August at US\$82.19/bbl and averaged US\$69.09/bbl during the 2006–07 financial year. Continued strong oil prices, together with a 30 per cent rise in crude oil quantity to reach 91 million barrels, saw the value of crude oil rise to \$7.6 billion. With the majority of fields showing decreased output due to maturity, the Enfield and Wanaea fields accounted for most of the increase. Crude oil, combined with condensate reached a total sales value of \$10.6 billion.

Leap-frogging alumina and LNG to hold third place is nickel, the star of the 2006–07 year, contributing \$8 billion (an increase of 110 per cent over the previous year) to the total value of the State’s resources. This dramatic increase in value was due to very high nickel prices. Nickel prices peaked in May 2007 reaching a new record of US\$54 200 per tonne (US\$24.58 per pound). At the same time sales quantities for nickel dropped by five per cent to 173 686 tonnes.

Alumina’s steady performance over the years continued through 2006–07 to claim fourth place behind nickel. A modest output increase of four per cent resulted in a record 12 million tonnes being shipped and a respectable 17 per cent increase in the value of sales to reach \$4.8 billion.

LNG sale volumes rose by five per cent to realise a record of 12.2 million tonnes (210 shipments) whilst sales values dropped by around eight per cent to \$4.2 billion. This makes LNG the fifth most valuable individual commodity in the State.

Gold output dropped slightly during 2006–07 by nearly six per cent to five million ounces (156 675 kg) and remains well below the peak output levels achieved in the late 1990s. This sector remains in sixth place behind LNG with a value of \$4.1 billion (up ten per cent). Strong gold prices continued throughout the year and were up by 21 per cent in US\$ terms and up by 15 per cent in A\$ terms.

Base metals joined the record breakers by achieving a value of \$1.68 billion for the 2006–07 period (a 71 per cent increase). This was achieved through strong commodity prices together with increased output from producers. All base metal sectors performed well, with copper increasing in quantity by 38 per cent, recording 112 280 tonnes, while value increased by 70 per cent to \$952.6 million. Zinc sales increased 17 per cent to reach 129 276 tonnes and record a value of \$618.9 million whilst lead quantities dropped three per cent to 56 927 tonnes, valued at \$112 million, up 30 per cent.

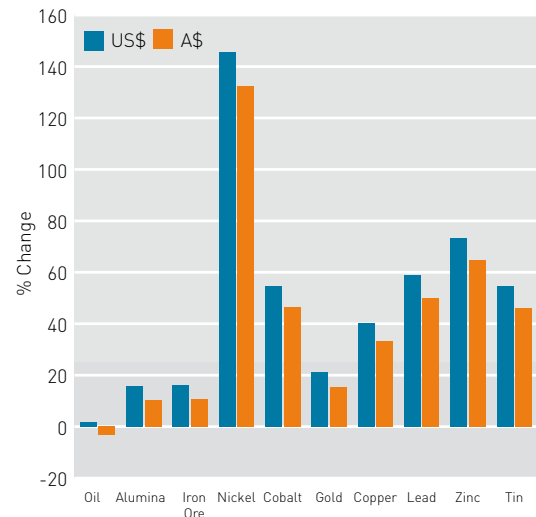


Figure 12 **Average Price Comparison 2005–06 and 2006–07**

Source: LME, Kitco, TEX Report, Metal Prices

LPG butane and propane also enjoyed an output increase of three per cent, returning a sales value of \$605 million, down eight per cent. Natural gas increased in quantity sold by nearly 13 per cent and an increase of 31 per cent in value to reach a record of \$919 million.

In line with the nickel industry’s lower output, cobalt sales volumes were down some three per cent, however price increases saw the sales values rise by around 51 per cent to \$279 million.

Salt tonnages were down by seven per cent to just over 10 million tonnes however values remained almost static at a little over \$228 million. Diamond sale volumes fell by nearly 38 per cent to around 18 million carats. Mineral sand sale values increased an estimated eight per cent to reach \$932 million.

Coal output and sales revenue were both down by around ten per cent due to changes in the overall use of coal for power generation in Western Australia.

The State’s resources in order of value for 2006–07 are:

	BILLION
IRON ORE	\$ 15.75
CRUDE OIL AND CONDENSATE	\$ 10.59
NICKEL	\$ 8.00
ALUMINA	\$ 4.82
LNG	\$ 4.24
GOLD	\$ 4.09
OTHERS	\$ 5.93

## RESERVE BANK OF AUSTRALIA (RBA) COMMODITY PRICE INDEX

The Reserve Bank of Australia Commodity Price Index is based on the price of 19 major commodities exported by Australia. These commodities collectively account for around two-thirds of total commodity exports. The index is apportioned into three sections – rural, non-rural and base metals.

The non-rural index comprises base metals (which consist of aluminium, copper, nickel, zinc and lead), gold, coking coal, steaming coal, iron ore, alumina and LNG. The index is compiled monthly and is expressed in US dollars, Australian dollars and Special Drawing Rights (SDR).

The RBA's index, expressed in US dollar terms is useful because most commodities are traded in world markets in US dollars. However such an index is subject to changes in the US dollar exchange rate (as it is based on spot prices). In this respect, the SDR index is a better indication of underlying supply and demand for commodities than the US dollar index.

SDR is a unit of account used by the International Monetary Fund (IMF). Its value is based on a basket of currencies comprising the euro, Japanese yen, English pound and US dollar. Weights are assigned to each of these currencies to reflect their relative importance in world terms. The RBA expresses the SDR component of its index in US dollar terms, with commodity prices derived from the London Metal Exchange and Bloomberg and converted to monthly averages of daily data.

Alternatively, the Australian dollar index is useful for gauging the domestic currency price received by Australian commodity exporters as it reflects the interrelation between world commodity prices and the Australian exchange rate. For example, if prices in foreign currency terms remain unchanged but the Australian dollar depreciates, this will be recorded as a favourable upward shift in the index, which would not be evident in either the SDR or US dollar index.

The RBA index is a fixed-weight Laspeyres index, using 2001–02 as the base year and excludes crude oil. The index is re-based every five years in order to make long-run reliable comparisons, unlike the national accounts that are re-based annually to track short-run movements. Base-period weights indicate the relative importance given to individual commodities. They are based on gross exports thus explaining the omission of crude oil (for which Australia is a net importer) and correspond to the export value of each commodity as a share of total exports. These weights change over time to reflect changes in the composition of commodity exports. Movements in the index from one period to the next reflect underlying price movements and do not take into account changes in volumes.

## GLOBAL ECONOMIC CONTEXT

Increased activity in world mineral and energy markets, particularly from China, has pushed the State's resource sector to record values of production and taken Western Australia's economic growth to high levels in recent years.

Record growth in Western Australia's resource sector and investment in the State's mining and petroleum industry reflects the State's abundance of valuable raw materials. Together with the State's proximity to key Asian markets, this advantage continues to play in Western Australia's favour, with the investment boom likely to continue in the foreseeable future.

Investment undertaken in the State and national mining sectors is making an impact on the State's export performance, with mineral and energy exports out of Western Australia rising by around a quarter in 2006–07 to more than \$54 billion. This accounts for 88 per cent of all Western Australian merchandise exports and for 34 per cent of national merchandise exports.

The rise in resources export earnings in Western Australia has been largely driven by higher world prices for key commodities such as iron ore, petroleum, gold, LNG, nickel and alumina. Notwithstanding price effects, export volumes have also increased on the back of high levels of investment.

The next few years promise to deliver yet more growth in export volumes as many development projects currently underway reach completion. These trends are also expected globally, as miners around the world are currently engaged in expansion projects across a variety of mineral and energy sectors to take advantage of strong global demand.

Additional output is expected to ease tight supply-demand conditions in the market for many commodities, which have seen prices reach record or near record levels in recent times. Whilst this will help moderate price pressures, as a result of continued strong global demand prices are generally expected to remain at high levels.

A significant impetus to global demand has been the rapid expansion of China's economy in recent years. China is growing to be a leading consumer of many mineral and energy goods. Reflecting this, China has recently taken over from Japan to lead iron ore contract price negotiations with major suppliers for the 2007–08 year.

These effects are expected to continue in the medium term, fuelled by China's continued growth, which is estimated to have grown by an annualised rate of 12 per cent in the June quarter of 2007 and follows annualised growth of 11 per cent in the March quarter of 2007.

China's consumption of raw materials is predominantly fed into its expanding manufacturing export sector as well as into its domestic economy, where urbanisation and increased consumer wealth requires infrastructure development. Both of these sources of growth look set to continue. Although China's export sector is closely linked to demand in the USA, where economic growth is expected to soften in the near term, demand for Chinese exports

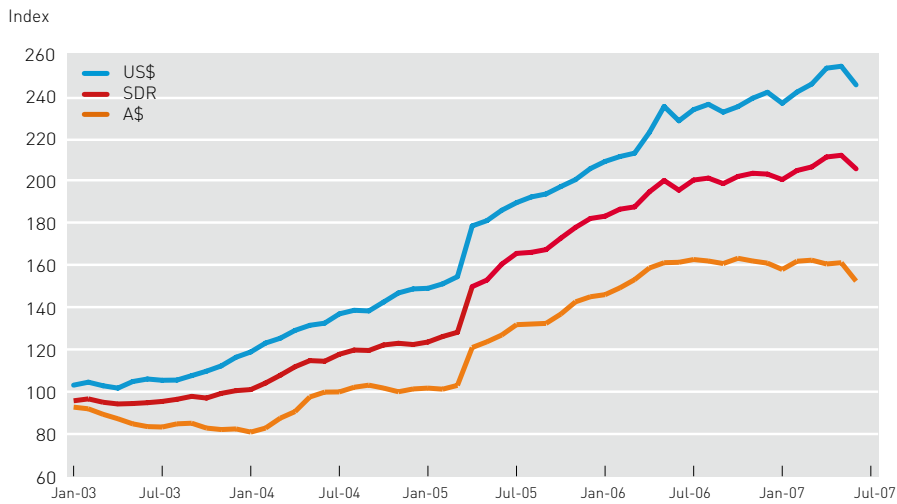


Figure 13 | **Non-Rural Commodity Price Index** (2001-02 = 100)  
Source: Reserve Bank of Australia

should be supported by demand from Europe and Japan, where signs of economic improvements are emerging. On the domestic front, China's economy will also be supported by further investment undertaken in the lead-up to the Beijing Olympics in 2008.

While demand should remain firm, the growth in the future supply of mineral and energy commodities in Western Australia has been affected by the persistence of capacity constraints. This has hampered the speed with which additional supply has entered the market in recent times.

Anecdotal evidence suggests that miners continue to experience difficulty in recruiting qualified labour and finding suitable sub-contractors. In addition, many project proponents are facing high costs in sourcing building materials, accommodation and in hiring and purchasing equipment. Combined labour and materials shortages have placed upward pressure on development costs.

Concerns around the US economy, in particular about US sub-prime mortgages and whether problems in the housing sector would spread to the broader economy have weighed on the US dollar. The US dollar has hit a near record low against the Euro and has fallen against the yen and other currencies including the Australian dollar. However, at the time of writing, commodity prices have also fluctuated strongly directly in response to recent financial market turmoil. The general consensus is that prices will revert to previous trends as calm returns. However, there is a risk that should problems in the sub-prime mortgage sector and collateralised debt obligations (CDOs) spread to the broader economy, petroleum and mineral commodity prices could be affected.

North America for example, accounts for some 30 per cent of the total demand for oil and as the supply-demand imbalance narrows from a contracting economy and prices begin to fall, OPEC's commitment to limiting supply might waver. These factors could see an easing in oil prices which may be compounded by speculation in oil markets. Commodities futures have been driven by many of the same factors that have supported the increased appetite for risk more broadly - and accentuated the bull trend in oil prices over the past four years. A liquidity crisis would reverse this, compounding the fall in prices brought about by shifting fundamentals.

Mineral commodities can likewise be vulnerable to a correction and even more so than petroleum. Mineral prices, particularly base metals, have risen to very high levels, appreciably higher than marginal costs. Weakening demand could coincide with expansions in mining and refining capacity to produce a sharp effect on prices.

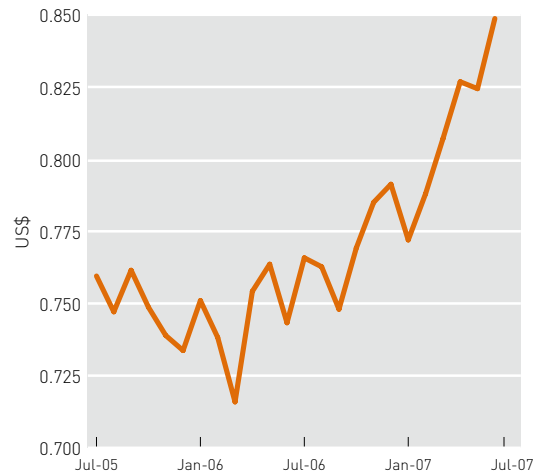


Figure 14 | **Exchange Rate US\$/A\$**  
Source: Reserve Bank of Australia

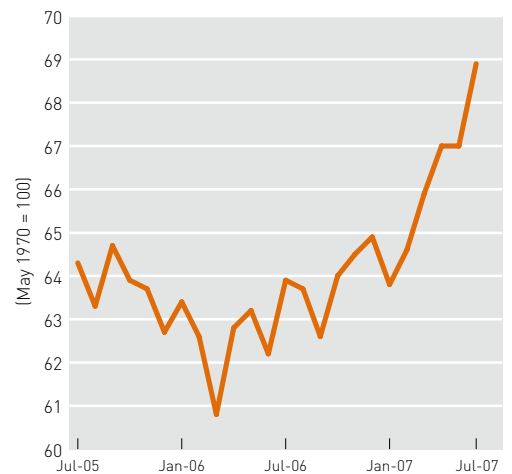


Figure 15 | **Exchange Rate Trade Weighted Index** (units of foreign currency per A\$)  
Source: Reserve Bank of Australia

## 2.2 PETROLEUM

### OIL AND CONDENSATE

Western Australia is the nation's premier petroleum producer, accounting for approximately 69 per cent of natural gas production and 71 per cent of national crude oil and condensate production. The Western Australian petroleum industry is the most valuable resource sector in this State and the value of oil and gas production continues to break records.

International oil prices remain strong which is not only bolstering the value of production but also providing an incentive for further investment in the industry. In 2006–07 for example, the average value of crude oil (based on a combination of West Texas Intermediate, Brent and Tapis) was US\$65.46 per barrel. This represented a firm outcome which was actually a two per cent improvement on the previous financial year. However, detracting from returns to local producers was a five per cent appreciation of the Australian dollar against its US counterpart during 2006–07.

Crude oil prices are expected to remain strong. OPEC's production cutback earlier this year has led to a much tighter global market and demand, led by a rebound in the US and continued strength in China and the Middle East, will remain strong. Outside of OPEC, supply growth is slowing, following project slippages, rising costs and declining reserves. OPEC therefore needs to increase supply significantly for shortages not to intensify. However, OPEC appears to be targeting a higher price-range and with no slackening foreseen in geopolitical tensions, the average price of crude oil is unlikely to change significantly and remain close to historical highs. Prices may however ease out to 2009 as demand reacts to soaring energy costs and investment by OPEC in additional capacity.

The strong price of oil combined with production increases resulted in the total value of Western Australian petroleum production increasing by more than 11 per

cent in 2006–07 to an all time high of \$16.4 billion. This impressive outcome has been achieved against a difficult background of not only declining liquids production from mature fields but also adverse weather conditions in the early stages of 2007 and the aforementioned strengthening in the Australian currency.

A jump in the State's crude oil production has been an important factor behind this increase. Crude oil sales climbed almost 30 per cent during 2006–07 to reach 91 million barrels (14.5 million kilolitres) worth \$7.6 billion, making crude oil the third most valuable single commodity in Western Australia after iron ore and nickel. Against a Western Australian landscape of general decline in output from mature oil fields, the boost in crude oil sales is due to significant output increases from new projects such as Roc Oil's Cliff Head operation and in particular, a boost in output of more than 12 million barrels from Woodside's new Enfield project. Improved operational uptime and successful development drilling to offset natural decline also saw Wanaea's output increase significantly in 2006–07.

Crude oil output in the near future should receive a boost with BHP Billiton's Stybarrow oilfield expected to start production in the first quarter of 2008. Later, production should also come from its Pyrenees oil development in the Exmouth Sub-basin. This development is to comprise a floating production, storage and offloading (FPSO) vessel capable of producing about 96 000 barrels of oil per day that will be tied into 13 subsea wells in the Ravensworth, Crosby and Stickle fields in WA-12-R. Production is expected to start in the first half of 2010.

Associated with higher volume of gas sales, the amount of condensate sold during 2006–07 likewise climbed, to 36.9 million barrels (5.9 million kilolitres), representing a four per cent increase compared to the previous financial year. In sales value terms this was worth \$3.0 billion, representing a six per cent increase on the previous financial year. The volume of LPG butane and propane sold also increased, by three per cent to reach 899 000 tonnes valued at \$606 million.

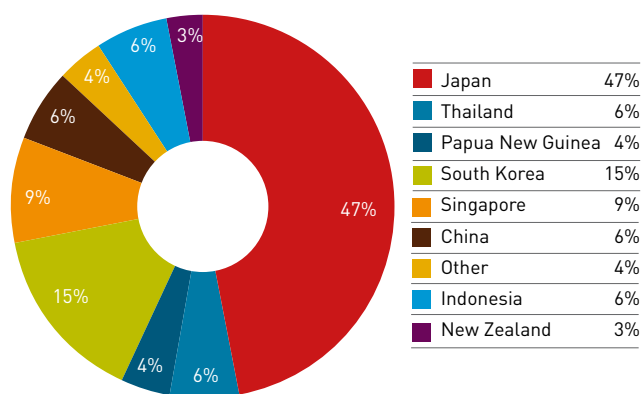


Figure 16 | **Petroleum Exports**  
Total Value \$10.64 billion Source: DoIR

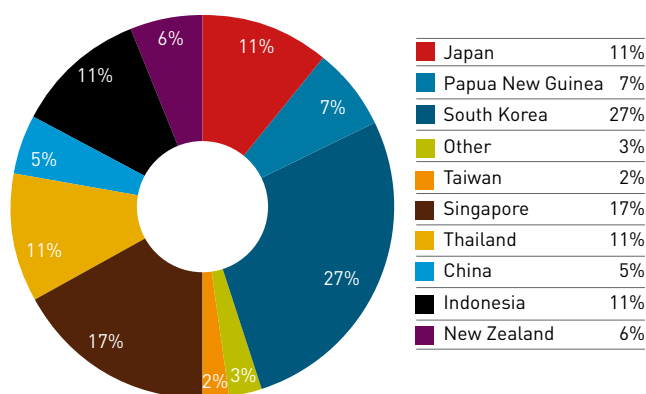


Figure 17 | **Crude Oil and Condensate Exports**  
Total Value \$5.79 billion Source: DoIR

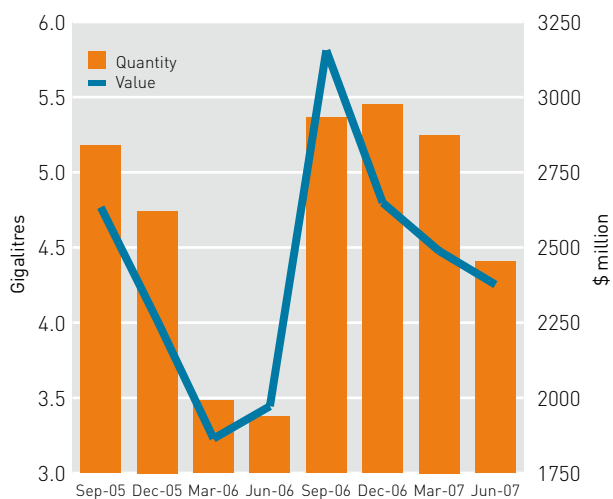


Figure 18 | **Crude Oil and Condensate Quantity and Value by Quarter**  
Source: DoIR

## NATURAL GAS

As expected, strong demand for natural gas in Western Australia saw the volume of domestic sales increase by 13 per cent during 2006–07 to a total sales volume of 8.7 billion cubic metres. This equates to 331 million gigajoules or 908 terajoules per day. The summed value of this gas amounted to \$919 million which represented a 31 per cent increase on 2005–06. This value is based on the summation of total domestic gas sale values as at the point of entry into the Dampier to Bunbury natural gas pipeline (DBNGP), or where applicable, the Parmelia pipeline. The graph included showing the price of domestic gas in Western Australia is calculated on this value and the aforementioned total volume of sales. In the current energy climate, as expected, the average price of gas sold in Western Australia continues to climb, with an average price of \$2.77 per gigajoule recorded for 2006–07.

Auguring well for a potential increase to the State's gas supply have been new discoveries and developments. Partners in the Reindeer field, Apache and Santos have begun front-end engineering and design studies for the gas field in the offshore Carnarvon Basin. Reindeer is located in permit WA-209-P. The studies will focus on the preferred development option – an unmanned offshore platform with a pipeline to a new gas processing facility to be sited on the mainland. The proposed production capacity is approximately 110 terajoules per day of sales gas.

There have also been new discoveries in Commonwealth waters off the coast of Western Australia. During July and August 2007, 130 kilometres north of Onslow, Apache Oil made another gas discovery at its Rosella 1 well in 96 metres of water depth. The well is located 20 kilometres from the John Brookes gas field which is already producing gas for the domestic market. This new gas discovery has the potential to tie into Apache's nearby pipeline and production facilities which service Western Australian domestic gas supplies.

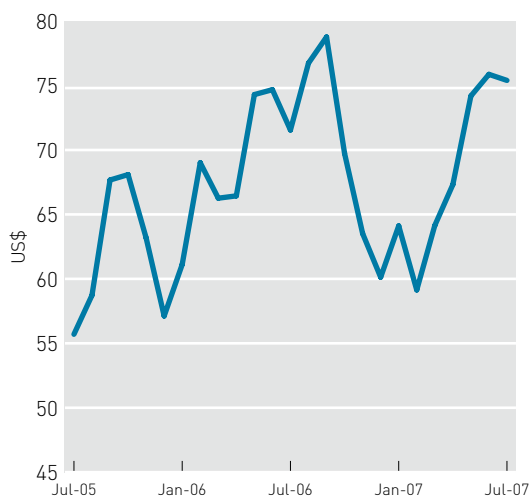


Figure 19 | **Tapis Crude Oil Price US\$/bbl**  
Source: WA Treasury Corporation

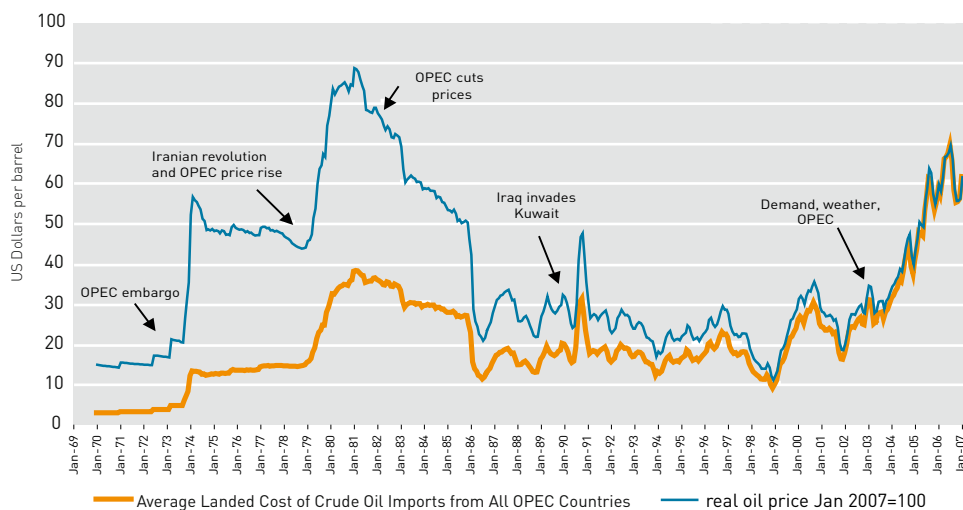


Figure 20 | **Historic Oil Prices** Source: Energy Information Administration, US Department of Energy; DoIR

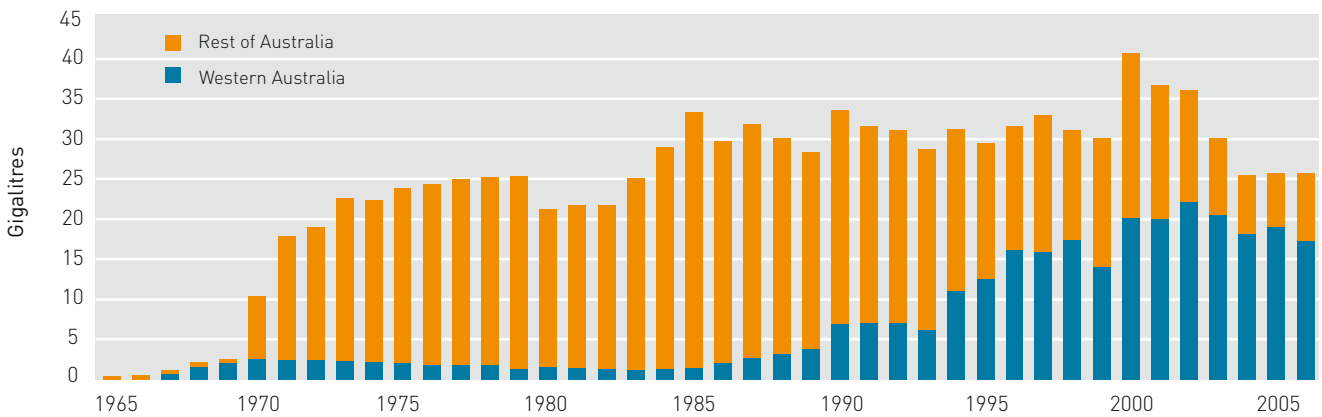
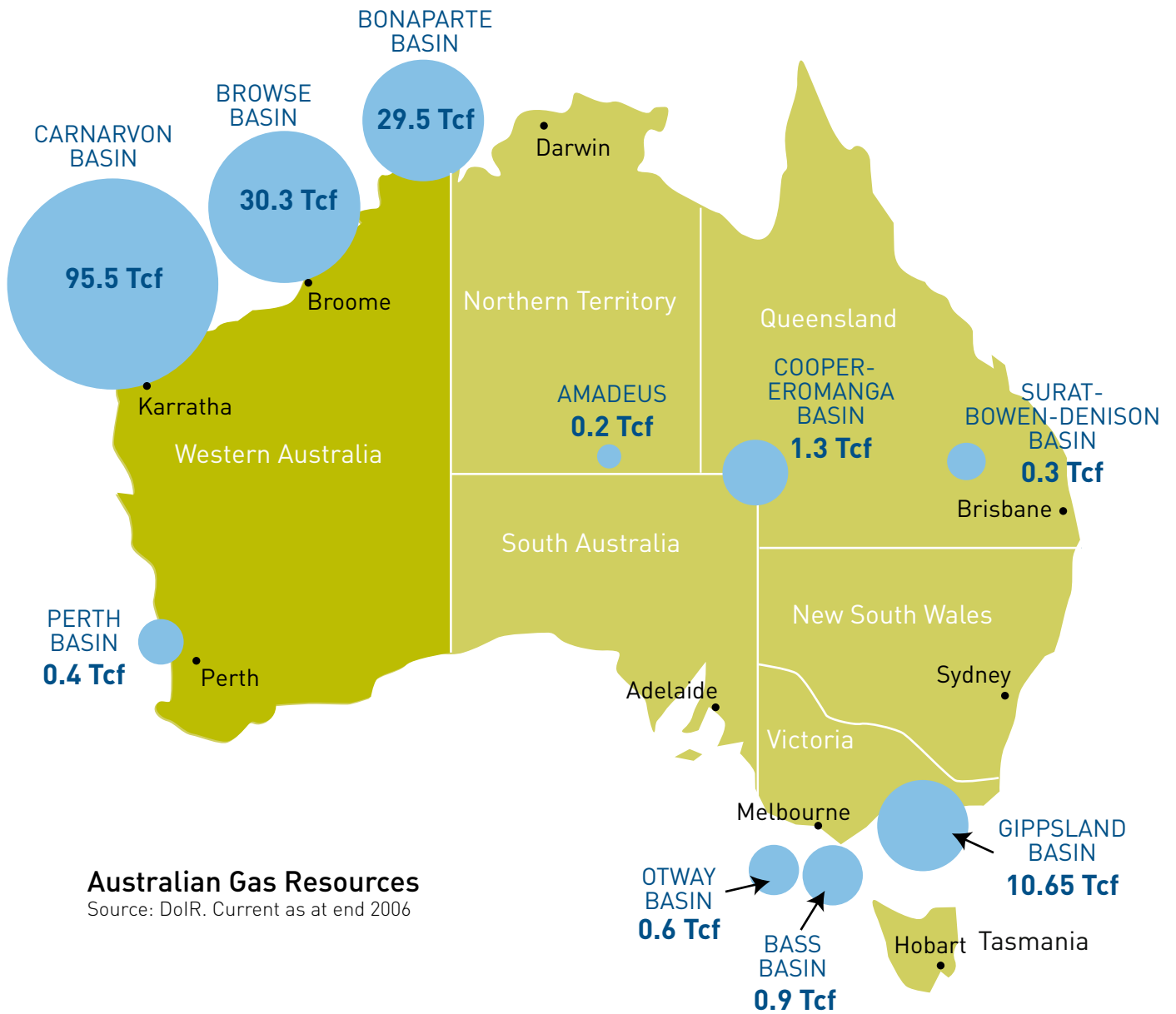


Figure 21 | **Crude Oil and Condensate Quantity** Source: DoIR and ABARE



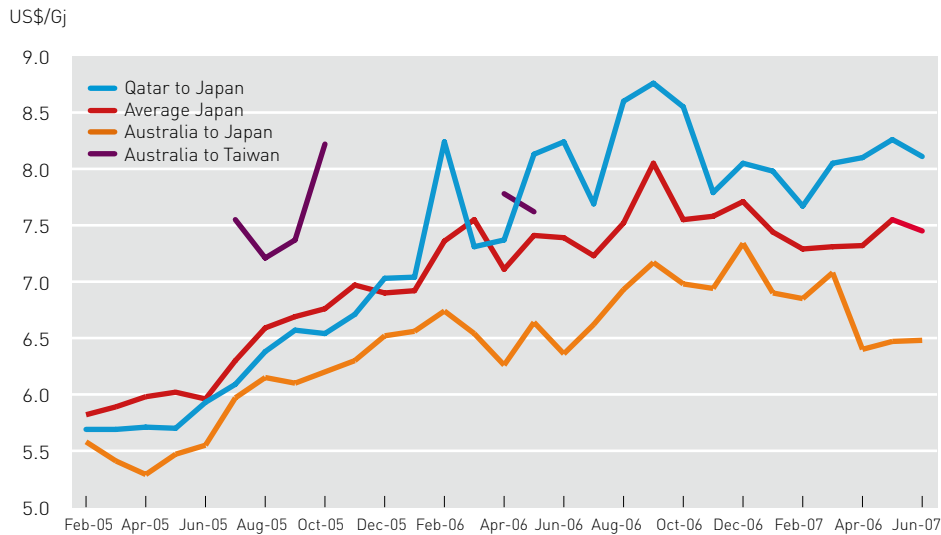


Figure 22 | **LNG Import Prices** Source: Argus Monthly LNG

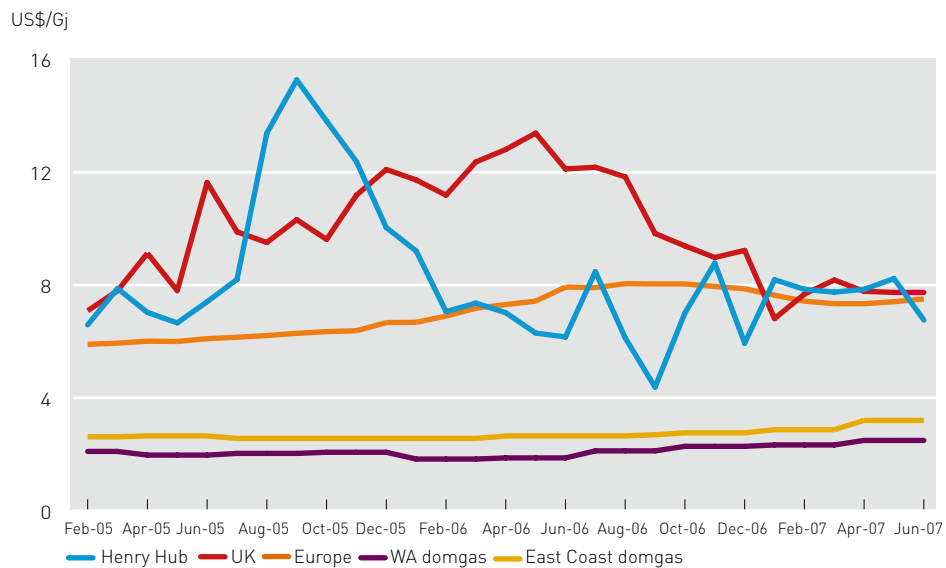


Figure 23 | **Average Natural Gas Prices** Source: Argus Monthly LNG, EnergyQuest, DoIR

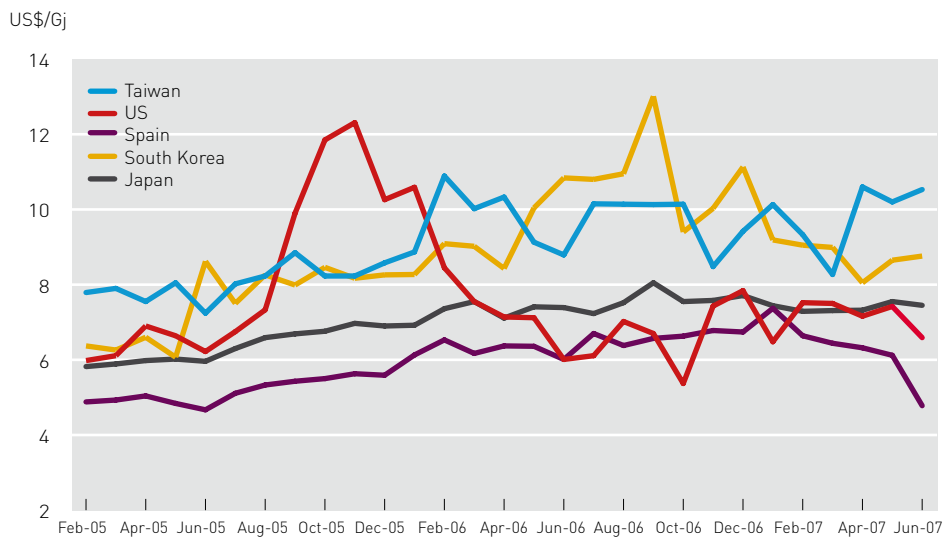


Figure 24 | **Average LNG Import Prices** Source: Argus Monthly LNG

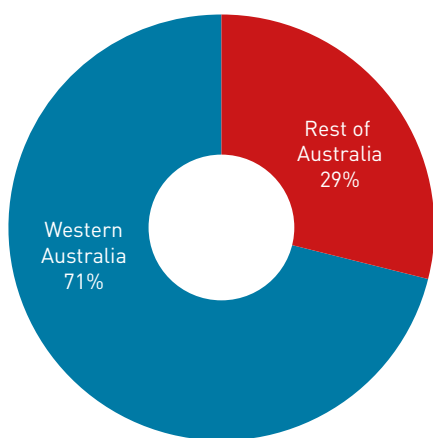


Figure 25 | **Crude Oil and Condensate Production 2006-07**  
Source: ABARE

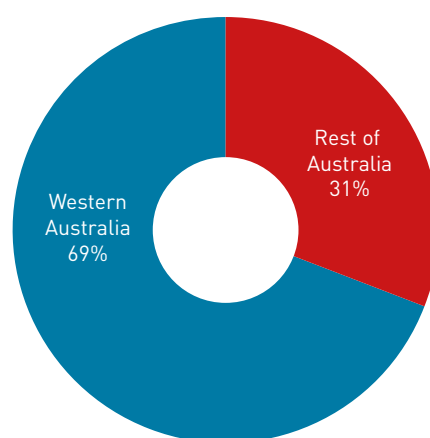


Figure 26 | **Natural Gas Production 2006-07**  
Source: ABARE (Data includes LNG feedstock)

## LNG

During the March quarter of 2007, following adverse cyclonic weather conditions, another giant of the resources industry, LNG, suffered from a reduction in export volumes due to disruptions in both production and port operations. Nevertheless, through the entire course of 2006-07, Western Australian LNG sales volumes still managed to grow by more than four per cent. However, in 2006-07, the appreciation of the Australia dollar combined with a higher proportion of lower-priced shipments resulted in the total sales value of LNG being down by eight per cent to \$4.2 billion. These reported values are based on shipped, delivered prices.

All LNG from Western Australia emanates from the NWS joint venture project in Karratha which comprises four LNG production unit trains. Commissioned in August 2004, the 4.2 million tonnes per annum fourth train is Australia's largest single LNG production unit.

Train 4 boosted NWS production to a total of 12.2 million tonnes in 2006-07 and its design is being replicated in Train 5, now under construction on the Burrup Peninsula. When completed in 2008, it will lift the project's capacity to about 16.3 million tonnes a year and make it one of the largest LNG plants in the world.

However, Western Australia is no longer the nation's sole LNG producer with ConocoPhillips and its partners commissioning the 3.5 million tonnes per annum Darwin LNG plant earlier in 2006. It is possible Darwin LNG could see the construction of a second production train by 2013 using gas from the Greater Sunrise fields or the Caldita discovery in conjunction with other as yet undiscovered fields in the Timor Sea and Bonaparte Basin.

Whilst Darwin LNG has become Australia's second LNG hub, after the NWS, it is not the last. In July 2007 the Woodside Board approved additional funding of up to \$11.2 billion and development of the Pluto LNG Project, subject to receipt of final environmental and other regulatory approvals. Preliminary site works for the onshore facilities for the Pluto LNG project began in January 2007. The project is based on Woodside's Pluto and Xena gas fields located about 190 kilometres northwest of Karratha in permit WA-350-P. These fields hold an estimated 3.7 trillion cubic feet of gas (reported to DoIR as at 31 December 2006 at P50).

The initial phase is to include a single LNG train, forecast to produce 4.3 million tonnes per annum. It will be connected by a 180 kilometre, 36-inch offshore pipeline to a platform in 85 metres of water. The platform will be connected to five subsea wells in the Pluto field, with first gas to be produced in late 2010. The LNG facility itself is to be based on the Burrup and later, with expansions, produce five to seven million tonnes per annum of LNG. Included in the project plan is funding towards additional infrastructure to facilitate future expansion for other Woodside or third party gas, allowing the onshore plant to operate as an open-access facility with additional LNG trains. also consideration is to be given to a domestic gas facility to supply the Western Australian market.

The project is to be underpinned by an integrated package of LNG Sale and Purchase Agreements, project equity and shipping arrangements with Tokyo Gas and Kansai Electric of Japan. This includes a 15-year sales agreement with Tokyo Gas and Kansai Electric totalling up to 3.75 million tonnes per annum of LNG. Tokyo Gas and Kansai Electric will also each construct and operate

an LNG ship to transport a combined 2.6 million tonnes per annum of LNG to Japan. An additional ship is to be constructed at Samsung Heavy Industries in South Korea by AP Moller Maersk and leased to Woodside on a long-term basis to transport LNG to Japan. In addition, a joint venture is to be formed with Tokyo Gas and Kansai Electric, enabling them to each take a five per cent equity in the Pluto permit (WA-350-P) and the Pluto Train 1 infrastructure, reducing Woodside's ownership to 90 per cent. Tokyo Gas and Kansai Electric also have options to participate in two additional Pluto trains and three Woodside exploration permits (WA-347-P, WA-348-P and WA-353-P).

Woodside is also appraising its extensive gas reserves in the Browse Basin, off Western Australia's Kimberley coast which have the potential for a major gas production hub. The Browse Basin area gas includes the Torosa (formerly known as Scott Reef), Brecknock and Calliance (formerly known as Brecknock South) discoveries. Combined, these fields hold an estimated resource exceeding 20 trillion cubic feet of gas and 300 million barrels of condensate. Options for an LNG development to process gas from these fields cover both an offshore and onshore processing plant. Potentially, the first cargo from Browse could be delivered from 2012–2014 subject to additional appraisal and customer negotiations. This would require a final investment decision to be made around 2008–2010.

Chevron is also considering an LNG and domestic gas development of up to ten million tonnes per annum based on Barrow Island, sourcing gas from its Gorgon and Jansz fields. Other additional potential LNG projects include Inpex's Browse Basin Ichthys LNG operation and BHP Billiton's Exxon Mobil's Pilbara LNG project to be based on the Scarborough field.

Underpinning the potential for LNG projects is the continued discovery of further gas resources in Commonwealth waters off the coast of Western Australia. Shell discovered gas at its Prelude 1 site located 220 kilometres off the Kimberley coast. The well, which was drilled during June and July 2007, is significant as it

indicates the Ichthys gas field is much larger than first expected. BHP Billiton has also made a significant deep-water gas discovery at its Thebe 1 well located in the Carnarvon Basin. The site is 350 kilometres northwest of Onslow and was drilled in July 2007, in 1173 metres of water depth. Preliminary estimations indicate that the Thebe gas reserves in the area range from two to three trillion cubic feet. The field will add more gas reserves to the outer Exmouth plateau region which includes the Scarborough gas field.

Western Australia, could therefore, potentially have several LNG projects operating within the next decade, depending on market conditions and progress on finalising the developments. In a global context, this potential future number of LNG projects in Western Australia is not unusual when considering various forecast growth rates for the LNG industry as a whole which range from seven to ten per cent annual growth in LNG production.

The boom in LNG developments on drawing boards reflects soaring demand around the world and Western Australia is very well placed to serve East Asian markets, as well as the east coast of India and the west coast of the US. The US for example, is making rapid progress in accommodating LNG with 12 new terminals being considered, including five in California, although terminals actually located in California are facing tough community opposition.

There have also been major advances in liquefaction technology, making small-scale LNG an increasingly viable proposition. In Kwinana, south of Perth, Wesfarmers' \$138 million, 175 tonnes per day domestic LNG project will produce fuel for heavy trucks and regional power generation. It is currently expected to be commissioned by the first quarter of 2008.

Elsewhere in the State, Energy Developments Australia has been in the process of building and commissioning its own small plant, which will produce LNG near Karratha for trucking to remote power stations in Broome, Fitzroy Crossing and Derby.



© Woodside

## 2.3 IRON ORE

The State's iron ore industry is experiencing a period of unprecedented growth fuelled by the burgeoning economy across Asia, particularly China. In 2006–07 the iron ore industry again broke new records in terms of output to reach 258 million tonnes and \$15.75 billion in sales. This is a remarkable result given the past year has seen producers face insufficient labour and skills, shortages of materials, rising capital and operating costs and time delays. Another severe cyclone season, with three cyclones in as many weeks, also hampered the efforts of producers, reducing exports.

The iron ore industry plays a pivotal role in Western Australia's export-driven economy, contributing \$15.34 billion or 30 per cent of the total value of mineral and petroleum sales for 2006–07. This equates to around \$1.8 million per hour and accounts for 28 per cent of the State's merchandise exports. Supported by Chinese demand, iron ore sales reached record volumes for an eighth consecutive year, increasing by six per cent to 258 million tonnes.

China dominates Western Australia's iron ore exports, accounting for over half (54 per cent) of the total amount shipped for 2006–07. Japan received 29 per cent during 2006–07 whilst other markets were South Korea (ten per cent), Taiwan (five per cent) and Europe (four per cent).

### IRON ORE PRODUCERS

Whilst the larger iron ore operations are based in the Pilbara region of Western Australia, there are also three mines in the Kimberley region, two in the Mid West region and one in the Wheatbelt. Rio Tinto Limited (with its wholly owned subsidiary Hamersley Iron Pty Ltd and its 53 per cent shareholding in Robe River Mining Company Pty Ltd) and BHP Billiton (BHPB) dominate the industry in Western Australia and account for around 95 per cent of the State's iron ore production.

Hamersley Iron owns five mines (Brockman, Marandoo, Mt Tom Price, Paraburdoo and Yandicoogina) and also operates the 60 per cent owned Channar mine, a joint venture with an Australian subsidiary of the China Iron & Steel Industry and Trade Group and the 54 per cent owned Eastern Range mine, a joint venture with Shanghai Baosteel Group Corporation.

BHPB operate seven mine sites including the largest single-pit, open-cut ore mine in the world – the massive Mt Whaleback mine in Newman. Nearby are the satellite ore bodies 18, 23, 25, 29 and 30, Jumblebar, Yandi, Area C and Yarrie.

Robe River operates the Panawanica mine and West Angelas mine.

The smaller producers consist of:

- Portman Limited with its Koolyanobbing operation about 50 kilometres northeast of Southern Cross and its smaller operation at Cockatoo Island, around 140 kilometres north of Derby.

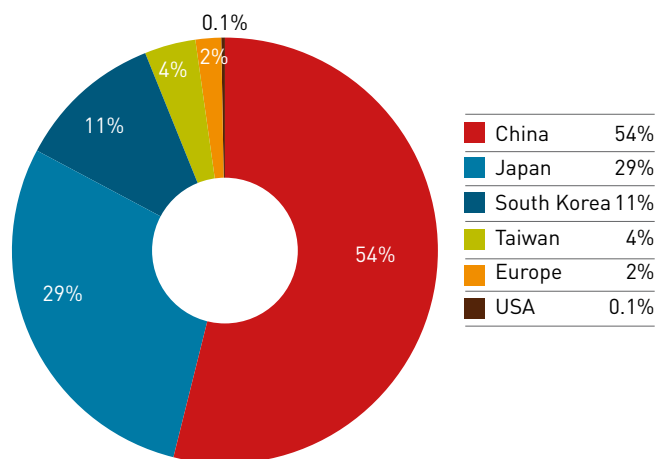


Figure 27 | **Iron Ore Exports**  
Total Value \$15.34 billion Source: DoIR

- Mount Gibson Mining Ltd with its Talling Peak operation, 50 kilometres north-northeast of Mullewa, and its recently acquired Koolan Island hematite mine, located in Yampi Sound off the Kimberley coast.
- Midwest Corporation Limited with its Koolanooka operation, 200 kilometres east-southeast of Geraldton.
- Murchison Metals Ltd's Jack Hills mine, located 140 kilometres northwest of Meekatharra and 380 kilometres northeast of Geraldton.

Further information on the three newcomers who commenced operations in 2006 or 2007 is detailed below:

- Murchison Metals' \$750 million Jack Hills high grade hematite ore mine is located 380 kilometres northeast of Geraldton and is using contract mining, crushing and screening operations. Their first shipment left the Port of Geraldton in February 2007 bound for China. Ore is continuing to be transported to Geraldton by road to Murchison Metals' new ore stockpiling storage and transfer facility at the port of Geraldton before shipping overseas.

Murchison Metals proposes to develop the Jack Hills project in two stages. Stage 1 will initially produce 1.5 million tonnes per annum which commenced in the second half of 2006 increasing to two million tonnes per annum in 2008. Stage 2 involves increasing annual production of direct shipping of high grade ore up to 25 million tonnes per annum. The ore is planned to be railed to a new deep-water port facility at Oakajee, 22 kilometres north of Geraldton.

In June 2007, Murchison Metals announced that an agreement had been signed with Mitsubishi Development Pty Ltd (Mitsubishi) to develop major iron ore and infrastructure businesses in the Midwest region. Under the agreement (estimated to be worth \$3 billion) Mitsubishi will acquire 50 per cent of Murchison Metals iron ore business.

POSCO of South Korea, one of the world's largest iron and steel producers, hold a 12 per cent stake in Murchison Metals. They also have secured the right to purchase up to 10 million tonnes of iron ore per annum over a 25-year period from Stage 2 of the Jack Hills and Weld Range project also near Meekatharra.

- Midwest Corporation Limited's \$26 million Koolanooka-Blue Hills Direct Shipping Ore project commenced shipment of iron ore fines from stockpiles in February 2006. The project commenced at one million tonnes per annum. Mining and crushing are expected to commence early in 2008. Production will increase to 2 million tonnes per annum as reserves and infrastructure permit. The Koolanooka mine site is located 200 kilometres southeast of Geraldton with Blue Hills a further 70 kilometres east of Koolanooka.

Midwest Corporation Limited is in joint venture with Sinosteel at its Weld Range hematite project located in the Midwest region. Exploration drilling is well advanced and studies are underway.

- Mt Gibson Iron's Koolan Island mine was reopened in 2007 and shipped its first ore in June 2007. It is expected to reach its targeted ore production rate of 4 million tonnes per annum in late 2009. Almost 70 million tonnes of high grade (Fe at 67 per cent) iron ore was mined by BHP Minerals from Koolan Island between 1965 and 1994.

Mt Gibson Iron cemented its ties to Chinese steel maker Rizhao Steel with two new off-take agreements to supply up to 2.5 million tonnes annually from the Koolan Island mine and up to 900 000 tonnes a year from its Tallering Peak mine. At current ore prices and contracts running over 15 years, the deal is valued at more than \$1 billion.

All of the State's iron ore producers have made a significant contribution to this year's impressive performance. Western Australian producers continue to develop a holistic utilisation of their ore bodies by blending a wide range of ore types, using complementary chemical and physical characteristics to reduce product variability. These new products will provide greater stability over the long term and reduce customer stockpiling requirements.

## PROJECT EXPANSIONS

Since China first sent market signals in 2002-03 that it was rapidly growing its infrastructure needs and thus its intensity of steel demand, producers have been doing their utmost to capitalise on the current strong market by increasing supply through investment in expansions and exploration. Iron ore companies have been accelerating the development and expansion of their operations on an unprecedented scale. However ongoing acute shortages of mining inputs will continue to put pressure on costs as well as having the potential to slow the ongoing expansion and development of the iron ore industry. The full impact of some of these projects will not be realised until 2007-08 and beyond.

Estimated investment in these expansions amounts to around US\$4.7 billion (A\$6.6 billion) with another US\$16 billion (A\$19.4 billion) potential investment in new developments. Some of this expansion work includes:

- BHPB's \$1.53-billion Rapid Growth Project 3 (RPG 3) which will increase the capacity of its Pilbara iron ore operations to approximately 129 million tonnes per annum. The key elements of RPG 3 comprise the expansion of Area C mine by 20 million tonnes per annum, additional sidings on the Newman railway and port works at Nelson Point and Finucane Island. Initial production is forecast to begin in the last quarter of 2007 with full production anticipated by 2008-09.
- In March 2007 BHPB announced approval for the US\$2.15 billion Rapid Growth Project 4 (RPG 4) which will further increase system capacity across its Western Australian iron ore operations to 155 million tonnes per annum. Key elements include construction of crushing and screening facilities and a new car dumper at Mt Whaleback, a new ore processing plant at Jumblebar and ore handling plant upgrades at Yandi. Nelson Point and Finucane Island facilities will be improved and additional locomotives and ore wagons will also be added together with more mainline sidings. Initial production from this expansion is expected to commence in the first half of 2010.
- Rio Tinto's (Hamersley Iron's) \$700-million mine expansion of Yandicoogina will increase production from 36 million tonnes per annum to 52 million tonnes per annum. Once completed, this will make Yandicoogina the largest iron ore mine in the Pilbara. This latest expansion follows recent upgrades comprising a new wet processing plant to process low grade ore, an overland conveyor and tertiary crushing-screening facilities.
- Rio Tinto will invest US\$1.55 billion to further expand port facilities at Dampier (from 116 to 140 million tonnes) and Cape Lambert (from 55 to 80 million tonnes) which will increase its annual shipping capacity to a massive 220 million tonnes per annum. Completion of the Dampier expansion is scheduled for the end of 2007, with Cape Lambert scheduled to finish a year later.
- In support of the Yandicoogina and Dampier port expansions, Rio Tinto will invest a further US\$113 million in additional rolling stock and associated infrastructure to support the increased levels of production.
- The Port of Geraldton has undergone an upgrade to Berth 5 to include a new iron ore ship loader and modifications to adjacent berthing pockets to allow 240-metre iron ore carriers to call at the port. This \$35-million upgrade includes a dedicated iron ore berth which is critical to meet the increasing demand for iron ore exports from the area.

While the importance of majors BHPB and Rio Tinto/Robe River continues to grow in the marketplace, this period of strong demand and healthy prices has created a frenzy of new developers on a rapid development schedule to establish themselves.

For the past 40 years all iron ore mined in Western Australia has been hematite ore, however the State has massive resources of magnetite ore which has long been considered the poor cousin to hematite. The advantages of hematite ore is that it does not have to

undergo costly concentration to make it saleable. Chinese steel producers have long used magnetite, have well established technology and are behind an unprecedented push to develop a string of magnetite projects in Western Australia.

The past few years has seen large Chinese companies enter into joint ventures and invest in Western Australian projects in an effort to secure a foothold in the supply chain for raw materials and to capitalise on reducing input costs for their steelmaking. These investments, or commitments to invest, run into billions of dollars. This level of investment and off-take commitments demonstrates a confidence by the steelmaking industry in China and the future demand for steel.

## PILBARA PROJECT DEVELOPMENTS

In addition to the extensive expansions being carried out on existing mines in the Pilbara, there are a host of new projects either being developed or on the drawing board. Some of these are:

- Rio Tinto are proceeding with the US\$1.2 billion development of the Hope Downs iron ore mine and a 58-kilometre railway line connecting into the Pilbara Iron rail system near West Angelas. The rail link will have the capacity of carrying up to 30 million tonnes per annum of Marra Mamba ore to either Dampier or Cape Lambert for export. First production is expected early in 2008. The area is the subject of a 50:50 joint venture agreement between Hancock Prospecting Pty Ltd and Rio Tinto Iron Ore.
- CITIC Pacific Ltd (the largest specialist steelmaker in China) has acquired mining rights from Mineralogy to one billion tonnes of magnetite ore with rights and options to a further five billion tonnes.

CITIC Pacific's Australian operation is developing the Cape Preston Iron Ore Project on a fast track basis with Major Project Facilitation status granted in December 2006. It is located about 100 kilometres southwest of Karratha.

Total investment in the project is estimated to be over US\$3 billion and would include the construction of:

- o production and processing facilities
- o port and materials handling facilities
- o 25-kilometre slurry pipeline
- o accommodation infrastructure.

CITIC Pacific will build a 450MW gas-fired power plant and accompanying transmission lines near its production plants as well as a desalination plant near its port development to supply water for the project.

- Australasian Resources Ltd, through its wholly owned subsidiary International Minerals Pty Ltd (IM), has the right to mine 1 billion tonnes of magnetite ore from the southern block of the Balmoral resource, adjacent to CITIC's Cape Preston Iron Ore project.

The company has finalised negotiations with Chinese steelmaker, Shougang Corporation, for the development of the Balmoral South Iron Ore project and are currently completing a bankable feasibility

study in unison with Shougang entities. Pending the outcome of the study Shougang will finance the project and have agreed to the purchase of the iron ore products.

The Balmoral South project has been strengthened by CITIC's fast tracking of their adjacent Cape Preston project. Production from the Balmoral South project is expected to begin in 2010 and has a projected life of around 25 years.

- Fortescue Metals Group (FMG), a new entrant of the State's iron ore sector, has received State and Federal Government environment approval for their Cloud Break tenement in the Chichester Range. This project is scheduled to commission its \$2.4-billion project in the first half of 2008.

In late 2004, negotiations between the State Government, FMG and The Pilbara Infrastructure (TPI – a subsidiary of FMG) were completed for a State Agreement to facilitate a new \$1.4-billion multi-user railway and port infrastructure in the Pilbara. Under this agreement, TPI proposes to construct a 260-kilometre multi-user railway from iron ore deposits in the eastern and central Pilbara to Port Hedland and to develop new multi-user facilities at the port. In late November 2006 TPI was granted a Special Railway Licence (SRL) by the State Government of Western Australia. The SRL gives the necessary tenure for the railway for a period of 50 years and allows for all activities necessary for the construction, operation and maintenance of the TPI railway.

In March 2007 it was announced that Chinese steel giant, Baosteel, had underwritten a rolling expansion of FMG's Pilbara project by signing a long-term supply contract. Under the deal FMG is to supply up to 20 million tonnes of iron ore (worth US\$1 billion at current prices) to Baosteel annually. In mid-May 2007 FMG announced another off-take agreement (replacing a pre-existing agreement changing product type and volume) with Tangshan Iron and Steel Group, China's third-largest steel mill, to supply up to 20 million tonnes per annum. To meet increasing demand from Chinese steelmakers, FMG are planning further expansions to 200 million tonnes per annum.

In August 2007 the Shanghai Baosteel Group and FMG formalised a Joint Venture to explore and develop an area close to the Fortescue rail corridor between the mine site at Cloud Break and Port Hedland.

FMG has now secured off-take commitments for the entire planned initial production of 45 million tonnes per annum. Off-take commitments have also been secured (95 million tonnes per annum) for output emanating from the possible future expansion of the project.

- Atlas Iron Limited's Pardoo hematite project (subject to government approvals) is targeted to commence production around October 2008. Pardoo lies 75 kilometres east of Port Hedland by road and will initially produce one million tonnes of direct shipping grade ore annually before ramping up to three million tonnes a year by 2010.

With the potential to develop their magnetite deposit (a possible 10 million tonnes per year operation) on the same site at Pardoo, Atlas Iron are completing a detailed scoping study and will consider a range of options for commercialisation. With its close proximity to Port Hedland, development and operating costs are expected to be low.

In June 2007 Atlas Iron signed a Memorandum of Understanding with FMG whereby the company will have access to FMG's services for its suite of projects in the Pilbara. Interim port handling and ship loading services will be provided until completion of the expanded public access berth is commissioned at Utah Point (Port Hedland) around March 2009.

- Cape Lambert Iron Ore Limited has commenced a bankable feasibility study (BFS) on its 2.5 billion tonne Cape Lambert magnetite project, which is located just 11 kilometres northwest of Roebourne. Upon successful completion of the BFS, it is expected that the project could, subject to government approvals, be in production by late 2010 and is projected to produce around 10 to 15 million tonnes per annum of iron ore concentrate. The resource is located five kilometres from the coast and ten kilometres from Rio Tinto's Cape Lambert iron ore port with direct connection to nearby infrastructure (highway, gas and power) and the townships of Karratha, Roebourne and Wickham. It is also close to Dampier.

In an effort to secure iron ore supplies from Australia, Best Decade Ltd (who owns 78 per cent of Delong Holdings Ltd, a major steel manufacturing and trading group, which is headquartered in Beijing) has signed a binding agreement with Cape Lambert Iron Ore Limited for a 70 per cent stake (A\$250 million) in the Cape Lambert project.

- Aurox Resources Limited, with its Balla Balla magnetite iron ore project, located midway between Karratha and Port Hedland, signed a long-term sales agreement to supply Chengde Iron and Steel Group Ltd (Chengde) with three million tonnes per annum of iron ore concentrate commencing late 2009. The agreement links the sales price directly to the Hamersley Premium Fines price negotiated annually between the world's major steel producers and Australian iron ore suppliers.

Chengde is one of the world's largest low-cost vanadium producers, making vanadium slag as a by-product of steel production using a feedstock of vanadium-rich titanomagnetite concentrate. First production from Balla Balla will coincide with the expansion of Chengde's steel plant, located in the Hebei province in China from 4.4 to 8 million tonnes per annum steel by 2009. Chengde is part of the Tangshan Iron and Steel Group Ltd, one of the top three steel producers in China.

In July 2007, a second 15-year sales agreement with one of China's top 10 privately owned steel mills, RockCheck Steel Group, will allow Aurox to double the size of its \$300 million Balla Balla iron ore project to six million tonnes per year.

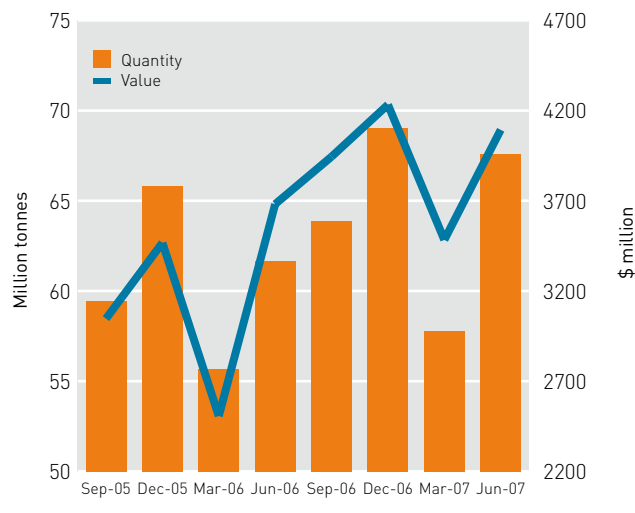


Figure 28 | **Iron Ore Quantity and Value by Quarter** Source: DoIR

The 300 million tonne magnetite Balla Balla project lies six kilometres from a natural gas pipeline, 220-kilovolt power lines and 9 kilometres from the North West Coastal Highway. The current strategy is to develop the project (subject to government and environmental approvals) in two stages. Stage one will be the construction of a \$320 million, three million tonnes per annum titanomagnetite concentration circuit, including associated infrastructure and slurry pipeline to Port Hedland, for a stand-alone operation. Stage two will be the construction of a \$290 million vanadium circuit.

The \$80 million slurry pipeline will be constructed to transport the concentrate between the Balla Balla operations and the new multi-user Point Utah port at Port Hedland where it will be dewatered and stockpiled before shipping. The Port Hedland Port Authority is considering options for utilising excess filtered water from the slurry pipeline for dust suppression and wash-down purposes.

## MID WEST DEVELOPMENTS

Oakajee is the Western Australian Government's preferred site for a new privately funded deep-water port to accommodate the rapidly expanding iron ore industry in the Mid West region of the State. In late 2005, the Geraldton Iron Ore Alliance (GIOA) was formed by a group of companies with iron ore deposits in the Mid West region of Western Australia. The primary role of GIOA is to promote the development of a viable and successful iron ore industry in the region. GIOA members consist of:

- Midwest Corporation Ltd;
- Gindalbie Metals Limited;
- Mount Gibson Iron Limited;
- Murchison Metals Ltd;
- Royal Resources Limited;
- Golden West Resources Limited;
- Asia Iron Holdings Limited; and
- Precious Metals Australia Limited.

GIOA's objectives can be divided into:

- The Northern Transport Corridor (development of a deep-water port at Oakajee to enable Cape-size ships to dock and load in the area and rail transport between inland mines and the new deep-water port), and
- The Southern Transport Corridor (the continued development of the Port of Geraldton and rail infrastructure between Geraldton and the Narngulu industrial estate with improvements to the road corridor to Narngulu and the Geraldton–Mt Magnet Road).

At the time of writing there were three major service providers vying to be the major supplier for the transport and shipping services for the Mid West iron ore industry.

- Yilgarn, backed by a group of Chinese steel mills and service providers including a commitment from China's EXIM Bank to underwrite the debt required for the project.
- Murchison Metals, backed by Japanese giant Mitsubishi.
- Mid West rail infrastructure provider, WestNet which is controlled by investment bank Babcock & Brown.

Listed below are some of the proposed mining projects in the Mid West area:

- Gindalbie Metals Ltd is developing the Mungada hematite project and Karara magnetite project (located 45 kilometres east of Koolanooka) in a 50:50 joint venture with Anshan Iron and Steel Group Corporation (AnSteel), one of the largest iron ore miners and steel producers in China. Under the joint venture agreement AnSteel will purchase 100 per cent of products up to 10 million tonnes per annum.

The \$90-million-plus Mungada hematite project involves mining direct-shipping hematite ore from Karara at an initial rate of two million tonnes per annum. Logistics involve mining, crushing and screening on site, followed by road haulage along the existing 85-kilometre haul-road to the rail head at Morawa for loading ore onto rail wagons for cartage on the existing Mid West railway network, 200 kilometres to the port of Geraldton. The project is progressing a BFS for completion by August 2007 with a start-up date projected to be some time in 2008.

The Karara magnetite project involves an estimated investment of over \$1 billion for the mining and processing of the 1.43 billion tonnes of magnetite resource. Some 20 million tonnes per annum of raw magnetite ore will be mined and concentrated at Karara to produce 8 million tonnes per annum of magnetite concentrate (68.8 per cent Fe). This material will then be transported via a slurry pipeline or railway to the Port of Geraldton where the concentrate will be shipped to the joint venture pellet plant at Bayuquan in China adjacent to a major new steel mill currently being constructed by AnSteel. Start-up date for the magnetite project is expected to be early 2010.

- In early 2006 Midwest Corporation Limited and Sinosteel (one of China's largest commodities trading houses) formed a joint venture agreement (Sinosteel/Midwest Joint Venture) at its Weld Range hematite project located in the Midwest region. Exploration drilling is well advanced and studies are underway. Sinosteel have agreed to off-take arrangements for both projects for 50 per cent of production with options to take up to 100 per cent of production.
- Mount Gibson Iron Limited's (MGI) \$88.1 million Extension Hill hematite project, located 260 kilometres southeast of Geraldton, has completed a detailed feasibility study for a three million tonnes per annum hematite mining operation. Subject to government approvals, the company anticipates that mining will commence in late 2008 or early 2009 with ore being transported via road to a rail siding near the town of Perenjori and then railed to the Port of Geraldton for export.
- Asia Iron Holdings Limited plan to produce five million tonnes per annum of magnetite concentrate at their Extension Hill magnetite project, subject to regulatory approval. The plan is for the concentrate to be transported by slurry pipeline to the port of Geraldton for export. Site construction is anticipated to commence mid-2008.
- FeroWest Limited is developing the Yalgoo Iron Project aimed at producing merchant pig iron from the Yogi magnetite mineralisation near Yalgoo in the Midwest region. The project's pre-feasibility study was released at the end of July 2007. Proposed initial production is 500 000 tonnes per annum moving to one million tonnes per annum in around five years. The plan is to process the iron ore into pig iron on the mine site.

## GREAT SOUTHERN DEVELOPMENTS

In May 2007, Grange Resources Limited entered into a joint venture agreement with the Japanese trading house Sojitz Corporation, for a 30 per cent stake in Grange's Southdown magnetite project, located 80 kilometres northeast of Albany. Sojitz will bring its expertise in pelletising to the venture which is expected to produce 6.8 million tonnes of pellets per annum over 22 years. The project is significantly advanced with key infrastructure in place and its proximity to rapidly growing markets in South-East Asia and the Middle East provides for significant freight advantages over the current supply from Brazil. The capital costs for the project are expected to be in the range of US\$1.175 billion, are subject to government approvals, and production of iron ore pellets is expected to commence in 2010.

In August 2007 Grange announced that it has signed an agreement with Rio Tinto Exploration Pty Ltd to acquire a 100 per cent interest in Rio Tinto's Exploration Licence E70/2512 containing the eastern six-kilometre extension of the Southdown magnetite deposit. The purchase of the exploration licence will substantially increase the total Southdown magnetite resource available for development.



## INNOVATION

The success of the State's iron ore industry rests critically on reliability, competitiveness and quality control in a demanding trading environment. Since its inception in the sixties, the industry has continued to improve its competitiveness in mining practices, technological innovation and management processes.

In the early 1980's, Rio Tinto commenced developing their HIs melt technology, a direct iron-making process in which iron ore fines and non-coking coals are injected directly into a molten iron bath to produce a quality molten pig iron. In 2002 Rio Tinto formed an unincorporated joint venture for the purpose of constructing and operating an 800 000 tonnes per annum HIs melt plant. Parties to the joint venture are:

- HImet Corporation Pty Limited, a wholly owned subsidiary of Rio Tinto Limited – 60%
- Nucor Australia, LLC, a wholly owned subsidiary of Nucor Corporation – 25%
- MC Iron and Steel Pty Ltd, a wholly owned subsidiary of Mitsubishi Corporation – 10%
- China Shougang International Trade and Engineering Corporation, a wholly owned subsidiary of Shougang Corporation – 5%.

Construction of the first commercial facility, at a cost of over \$400 million, commenced in 2003 with hot commissioning beginning in the 2nd quarter of 2005. A quarter of a century after its beginnings in 1980 and \$1 billion in the development, the first shipment of nearly 40 000 tonnes of pig iron from the HIs melt Kwinana Joint Venture facility departed in June 2006. By early December deliveries had topped nearly 83 000 tonnes and production is on track towards full capacity of 800 000 tonnes in 2008.

The HIs melt technology, a potential replacement for the blast furnace and as a new source of low-cost feedstock for the electric arc steelmaking industry, is poised for

worldwide licensing, offering low operating costs, low capital intensity, lower environmental impact, with greater raw material and operational flexibility. At the time of writing there are two licensees, who have signed a HIs melt Process Licence, the Laiwu Steel Group Ltd and the Nanjing Iron and Steel Group Jiangsu Huaigang Corporation Limited, both of China.

In February 2007 Rio Tinto opened its new high-tech Off-Road Tyre Retreading facility in Kewdale on the outskirts of the city of Perth. This facility, the first of its kind in the Australian mining industry, has been developed in response to the chronic shortage of heavy haulage tyres. The facility will be able to recycle haul-truck tyres (which last between six months to two years, depending on road conditions).

In August 2006 BHPB opened its global technology centre in the Australian Resources Research Centre at Technology Park in Perth. The centre is one of three BHPB global innovation centres with a combined funding of more than \$100 million each year. The other two centres are located at Newcastle in New South Wales and Johannesburg South Africa. With more than 20 per cent of BHPB's total assets located in Western Australia, the establishment of the technology centre in Perth underscores its long-term commitment and vision for this State. The centre will foster innovation and be staffed by a large team of technological professionals whose activities will cover the full spectrum from exploration tools, mining and processing technologies to environmental solutions. Activities currently cover the following areas:

- Exploration, mining and mine optimisation
- Leaching and remediation
- Minerals Separation and Hydrometallurgy
- Process Engineering
- Technical Marketing
- Intellectual Property.

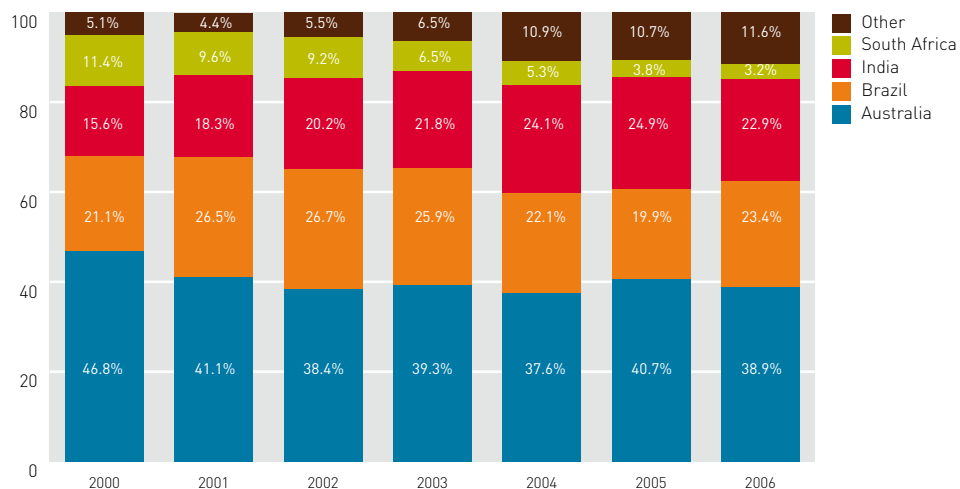


Figure 29 | China's Iron Ore Imports by Source Source: China Customs and The TEX Report

## IRON ORE PRICE, SUPPLY AND DEMAND

The world's big three iron ore producers' (Companhia Vale do Rio Doce [CVRD], Rio Tinto and BHP Billiton) case for a price increase for the contract year commencing 1 April 2007 was based upon ongoing high demand and constrained supply.

In contrast to the previous year's price negotiations, which were not finally concluded until June 2006, China's largest steelmaker, Baosteel, reached agreement on 22 December 2006 on the price for Western Australian iron ore deliveries for the contract year commencing 1 April 2007. Under this agreement the price of both lump and fine ore increased by 9.5 per cent, thus setting the standard for other Western Australian sales to European, Japanese, South Korean and Chinese-Taipei steelmakers.

With world steel production growing faster than previously expected and significant transport differentials in terms of landed price appearing, price increases (effective from 1 April 2008) negotiated by Australian producers could be significant.

During the past three years the price of iron ore has increased in total by 123 per cent. World production of iron ore is projected to grow by around 5.2 per cent to reach two billion tonnes in 2012. Most of this increase is expected to come from new iron ore mines and expansions in Australia and Brazil with substantial growth in both China and India as well. Because of their close proximity to the Asian markets, Western Australian producers are well placed to take advantage of these rapidly growing markets. With the anticipated new mine supply and expanded port handling capacity, it is expected that Western Australia will increase its share of the world iron ore trade.

By 2012 world steel consumption is projected to grow by 4.8 per cent a year to over 1.6 billion tonnes. In the short- and medium-term, China's industrialisation and rapid urbanisation will continue to be the most important drivers of growth in world steel consumption. This projected growth is underpinned by the fact that over the past four years China's consumption of steel has almost doubled from 207 million tonnes in 2002 to an estimated 396 million tonnes in 2006. In addition, countries such as India are also undertaking full-scale infrastructure investment.

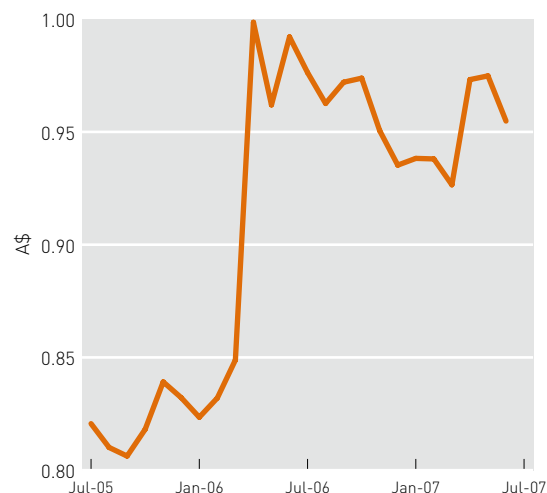


Figure 30 | **Iron Ore Price A\$/Fe unit**  
Source: Tex Report, High Grade Fine Ore Prices

This rapid growth in consumption will become increasingly important to the outlook for steel. By comparison steel consumption in developed economies such as the United States, Japan and the European Union is expected to remain relatively flat.

Analysts indicate that around 90 per cent of the future growth in the global iron ore market between 2006 and 2012 will be absorbed by China. There are also clear indications the central authorities in India are making progress with reforms which could unleash a sharp increase in steel demand and growth. The government recently unveiled plans to invest around US\$320 billion in infrastructure over the next five years including:

- A major new roads program;
- New rail corridors; and
- 90 gigawatts of new power generating and transmission capacity.

The State's iron ore industry is poised for a long-term future of high production rates with some initial challenging supply difficulties. It is an industry diversifying into new mines and a changing product mix with the major iron ore companies continuing to improve product quality and infrastructure.

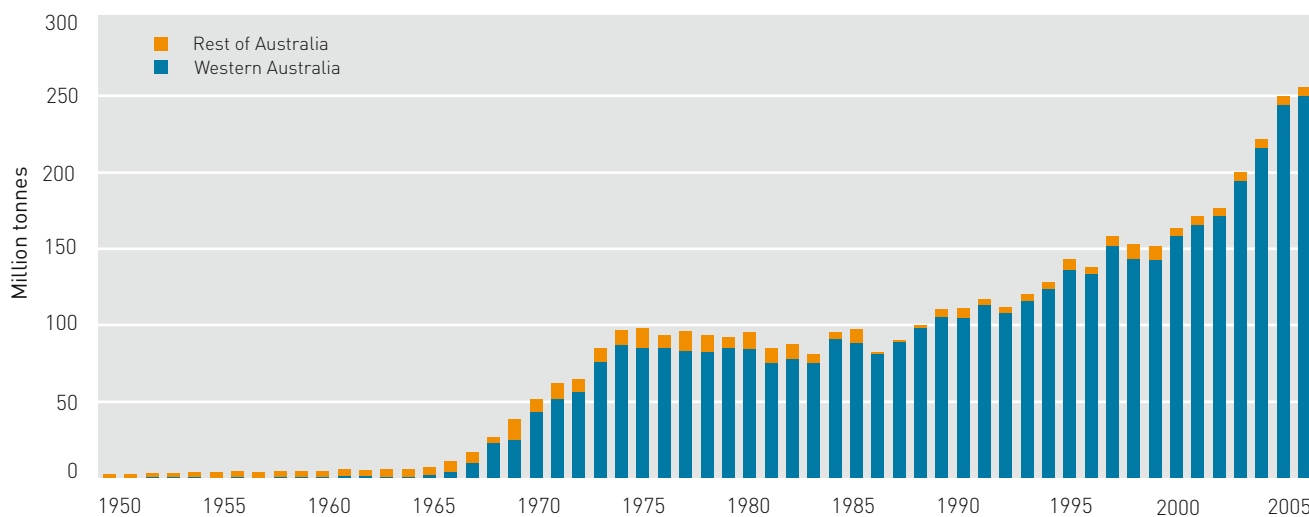


Figure 31 | **Iron Ore Quantity** Source: DoIR and ABARE

## 2.4 NICKEL

Western Australia celebrated its 40th anniversary since the State's first nickel mine opened at Kambalda with record nickel sales of \$8 billion in 2006–07. This was an increase of 110 per cent compared to 2005–06, placing nickel third in order of value behind petroleum and iron ore. Sale volumes actually fell by five per cent to 173 686 tonnes in the same period. Overall average prices received by exporters increased by a massive 132 per cent in Australian dollar terms from the previous period.

Stainless steel production accounts for about 65 per cent of world primary nickel use. Rising global stainless steel output, mainly from China, coupled with constrained global nickel ore supply, pushed nickel prices to record levels in the latter half of 2006–07 to reach US\$54 200 per tonne (US\$24.58 per pound) in May 2007. 2005–06 saw an average of US\$15 488 per tonne (US\$7.03 per pound) whilst 2006–07 rocketed to US\$38 050 per tonne (US\$17.26 per pound), around 146 per cent increase.

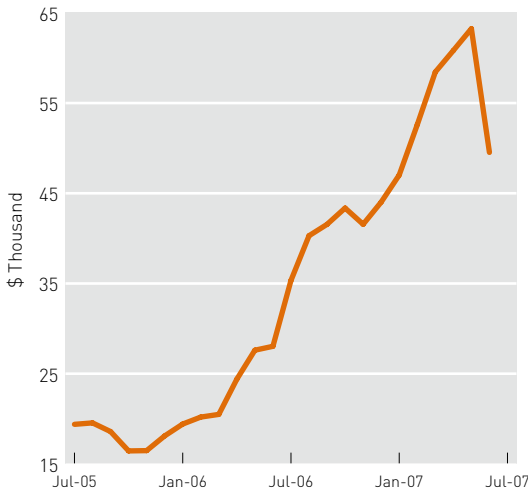


Figure 32 | **Nickel Price A\$/tonne**  
Source: LME Cash, Monthly Average

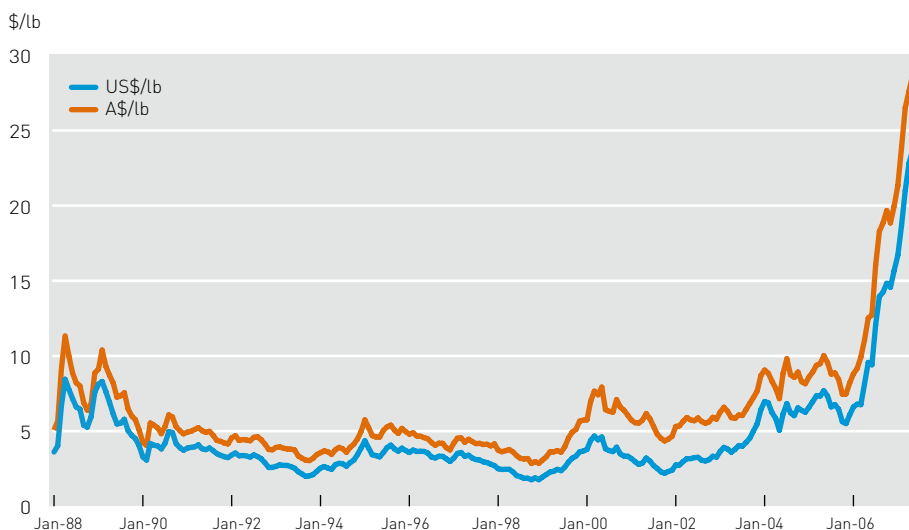


Figure 33 | **Historic Nickel Prices** Source: LME

With reduced inventory levels and no new smelter supply forecast to come on-stream until around 2009, prices are expected to remain strong for the next two years. Delays at BHPB's Ravensthorpe and Companhia Vale do Rio Doce's Goro project in the French territory of New Caledonia, the two largest nickel mines under construction, have exacerbated pressure on prices.

### CURRENT PRODUCERS

The Western Australian nickel industry remains heavily concentrated with the top five producers accounting for around 85 per cent of all nickel sales. The largest of these is BHP Billiton's Nickel West with concentrators at Mount Keith, Leinster and Kambalda, the Kalgoorlie smelter and the Kwinana refinery. Nickel West is the world's third-largest producer of nickel in concentrate.

The Murrin Murrin Joint Venture (Minarra Resources Ltd 60 per cent and Glenmurrin Pty Limited 40 per cent) is the second-largest producer with their laterite project located between Leonora and Laverton in the historic northeast goldfields region of Western Australia.

The third-largest producer is LionOre Australia (Nickel) Ltd with its Black Swan operations located 53 kilometres northeast of Kalgoorlie and its Lake Johnston operations (incorporating the Emily Ann and Maggie Hays underground mines) located 125 kilometres southeast of Marvel Loch.

The latest addition to LionOre's production output is its Waterloo nickel deposit situated five kilometres northwest of the Thunderbox gold mine in the North-eastern Goldfields region of Western Australia. Waterloo is an underground mine, exploiting an ore body between 100 to 400 metres below surface. Commercial scale production commenced in October 2006 with ore being processed by BHP Billiton at their Leinster concentrator, 35 kilometres north of Waterloo.

Other major producers include Mincor Resources' Miitel, Mariners, Redross and Wannaway nickel mines located 13 kilometres southeast of Widgiemooltha and Jubilee Mines NL with their Cosmos operations located 450 kilometres north of Kalgoorlie.

Since opening the Cosmos mine in 2000, Jubilee Mines' exploration program has identified additional resources and in 2006–07 transitioned to a multi-mine environment. Additional exploration drilling has the potential to extend the life of the Cosmos project to a very long-term operation.

A range of nickel sulphide producers also have toll treatment and concentrate purchase agreements in place with Nickel West, trucking ore to be concentrated at their Kambalda concentrator.

These operations include:

- Australian Mines Limited's Blair nickel operation;
- Independence Group's Long mine;
- Consolidated Minerals Limited's Beta Hunt, East Alpha deposit and Widgiemooltha North;
- Tectonic Resources NL's RAV8 mine at Ravensthorpe;
- Mincor Resources' Miitel-Wannaway project; and
- Sally Malay Mining Limited's Lanfranchi Tramways operation.

Recent upgrade of reserves at its Winner deposit, located one kilometre away from its existing Lanfranchi mine, will add significant nickel tonnes to Sally Malay Mining's production for 2007-08 and brings the company closer to its ultimate goal of 20 000 tonnes of contained nickel over 10 years.

The newest producer to come on-stream this year is Western Areas' Flying Fox deposit with its Forrestania Nickel Project. Located about 400 kilometres east of Perth, the Flying Fox deposit is one of the highest grade nickel deposits in the world. The deposit comprises of 1.4 million tonnes at an average grade of 6.5 per cent nickel containing approximately 90 500 tonnes of nickel. Underground production commenced in October 2006 with forecast product targeted at 13 000 tonnes of nickel in concentrate per annum by 2010. Ore produced from the Flying Fox tenement will be treated at the Emily Ann plant (located about 90 kilometres to the east) under the terms of an existing agreement with LionOre. A pre-feasibility study is nearing completion to bring a second mine into production at Diggers South, 40 kilometres south of Flying Fox.

While current Western Australian production is chiefly based on nickel sulphide deposits, most of Western Australia's nickel resources are laterite. However, operational problems in laterite processing have hindered development of these resources.

The combination of Western Australia's large nickel reserves and buoyant nickel prices has resulted in a range of exploration and development activities. Among the most significant is BHPB's US\$2.2-billion Ravensthorpe nickel laterite project that is envisaged to produce around 145 000 tonnes per annum of nickel-cobalt hydroxide

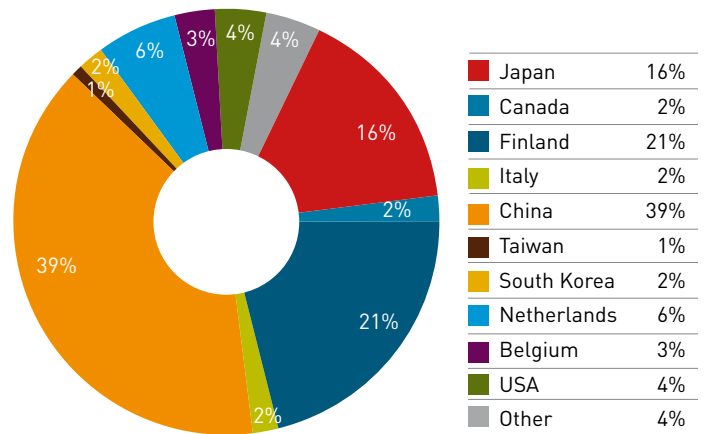


Figure 34 | **Estimated Nickel Exports**  
Total Value \$7.98 billion Source: DoIR

with a mine-life currently expected of around 25 years. Construction commenced in the first half of 2004 and over 1700 people have been employed on the site. First production is now expected some time in the first quarter of 2008. Ravensthorpe output will be shipped to the BHPB's Yabulu refinery near Townsville in Queensland. The Ravensthorpe operation will rival Murrin Murrin as Western Australia's largest lateritic nickel mine.

## MINE EXPANSIONS

With the completion of LionOre's Maggie Hays mine upgrade, it is anticipated that production will increase by approximately 20 per cent to over 14 000 tonnes per annum. The upgrade includes an expansion of the existing underground mining operations as well as an upgrade of the processing plant capacity to 1.5 million tonnes per annum. Poor ground conditions were encountered during the first quarter of 2007, delaying ramping up to full production levels until the third quarter of 2007.

In addition to the Maggie Hays upgrade, LionOre's Black Swan \$69-million upgrade involving pit expansion, plant construction and processing plant capacity improvement to 2.15 million tonnes per annum, was commissioned in the third quarter of 2006. Ramp-up to full production followed in the first half of 2007 although recoveries were adversely impacted upon by ongoing complexities with the mineralogy of the open pit ore. Several treatment options are under consideration to improve recovery levels.

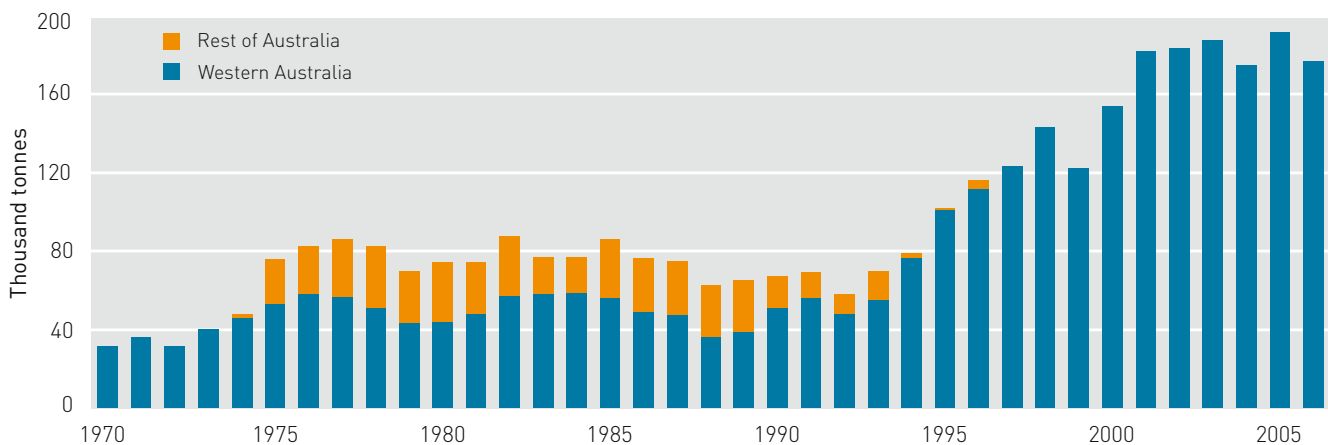


Figure 35 | **Nickel Quantity** Source: DoIR and ABARE

## PROJECTS UNDER DEVELOPMENT

In June 2007, Mincor announced a new \$28 million development of its 70 per cent owned Carnilya Hill project which is located 25 kilometres northeast of Kambalda. Once completed the mine is projected to operate at a rate of 5000 tonne of nickel per annum for around three years. Like its Miitel project, Carnilya Hill ore will be toll-treated and sold to BHPB under a long-term off-take agreement. First production for the project is targeted for January 2008.

Consolidated Minerals acquired the Widgiemooltha North Nickel Project through a takeover of Titan Resources in August 2006. All mining and environmental approvals have been received and it is expected that production from the Widgiemooltha project will commence in the September quarter 2007. Ore from the mine will be toll-treated at BHPB's Kambalda Nickel Concentrator and sold to BHPB under a long-term off-take agreement. Consolidated Minerals commenced shipments from their stockpiles in the June quarter 2007. The company plans to have three mines operating from the Widgiemooltha area within three years with an output of around 4000 tonnes per annum.

## OTHER PROJECTS UNDER CONSIDERATION ARE:

- Braemore Resources Plc is in the final stages of testing their nickel sulphide tailings project at BHPB's Leinster nickel operations. This project involves the production of a high-grade intermediate product in the form of nickel sulphide containing 61 to 65 per cent nickel from the reclamation and processing of sulphide nickel tailings from BHPB's Nickel West operations at Leinster, Mt Keith and Kambalda. During the past 40 years these operations have accumulated an estimated 163 million tonnes of tailings, containing approximately 500 000 tonnes of nickel. It is also estimated that a further 522 000 tonnes of nickel will be added to tailings from current processing to the completion of mining activities at Leinster and Mt Keith.

Should Braemore's project prove feasible, 10 to 20 000 tonnes of nickel per year will be produced in a nickel sulphide product, increasing production to 30 to 50 000 tonnes of nickel by further plant development at Kambalda and/or Mt Keith.

- The Copernicus nickel project, a joint venture between Sally Malay Mining Ltd (60 per cent) and Thundelarra Exploration Ltd, will proceed with the development of an open pit mine (subject to statutory approvals) with ore production scheduled to commence in the June quarter of 2008. Ore will be trucked to the Sally Malay plant for processing. Should underground operations proceed, mine-life would be extended to 2012. It is estimated that 6500 tonnes of nickel, 4750 tonnes of copper and 220 tonnes of cobalt would be produced over the initial four-year life of the open pit and underground mine.

- Australasian Resources Limited's Sherlock Bay nickel project located 70 kilometres east of Karratha is establishing a team to investigate the feasibility of establishing bulk leaching which, if successful, will provide the impetus to move the project toward to full-scale production. Sherlock Bay has potential for very low operating costs using standard heap leach techniques and a projected 10-year-plus mine-life at two million tonnes per annum.
- BHPB's Yakabindie project is based on a large nickel deposit situated near their existing Mount Keith operation. BHPB has completed a pre-feasibility study with consideration being given to developing Yakabindie as an integrated part of the Mount Keith project.
- Heron Resources' Goongarrie laterite nickel project, located about 85 kilometres north of Kalgoorlie. Heron and Inco signed a formal agreement in 2005 under which they will complete a feasibility assessment and if warranted, develop the project.
- A BFS is due for completion in the second quarter of 2007 on LionOre's Honeymoon Well project. Amongst one of the world's largest undeveloped nickel deposits, Honeymoon Well is located 53 kilometres northeast of Kalgoorlie. It is envisaged that the project would operate at around 10 million tonnes per annum producing in excess of 40 000 tonnes per annum of nickel in concentrate.

## OUTLOOK

Despite a correction during 2007, nickel prices remain relatively strong compared to their long-term average. Healthy prices, various mine expansions and new mines coming on-stream will ensure a very active period for the State's nickel industry in 2007-08. Western Australia is also likely to continue to account for all of Australia's nickel mining in 2007-08.

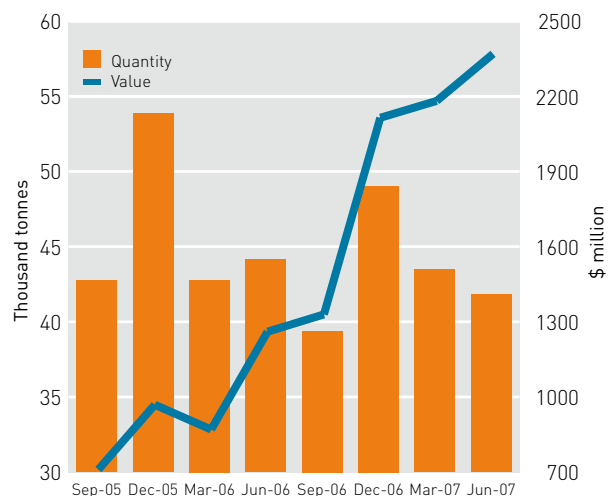


Figure 36 | **Nickel Quantity and Value by Quarter** Source: DoIR

## 2.5 ALUMINA

The State's alumina industry is the fourth-largest sector in terms of sales after petroleum, iron ore and nickel accounting for nine per cent of total mineral and petroleum sales. During 2006–07, the total quantity of alumina sold continued to break records with the quantity sold increasing by four per cent to 11.98 million tonnes in 2006–07, compared to 11.47 million tonnes in 2005–06.

Sale values increased by 17 per cent (\$709 million) to \$4.82 billion compared with 2005–06. The average annual alumina price (in Australian dollar terms) increased 9.5 per cent from \$365 per tonne in 2005–06 to \$399 per tonne in 2006–07. June 2006 was particularly strong with an average alumina price of \$430 however the July to December 2006 average eased back to \$408 and by June 2007 the annual average was at the \$399 mark. In terms of aluminium, in 2006–07 prices averaged US\$2699 per tonne which was 3.5 per cent higher than the record peak in 1988 when tight supply and demand conditions pushed prices to an average of US\$2607 per tonne. May 2007 saw a new all-time high of \$3100.

Australia is the world's largest bauxite and alumina producer. In 2006, Western Australia produced 32 per cent and 64 per cent of the world's and Australia's alumina respectively. The State's total alumina production has demonstrated an average annual growth rate of four per cent per annum during the past ten years.

The total value of alumina exports in 2006–07 was \$4.7 billion. Western Australia's markets for its alumina are very diverse with China taking 21 per cent, South Africa and Bahrain each 17 per cent, the United Arab Emirates accounting for 15 per cent, Mozambique eight per cent, Canada seven per cent, the United States six per cent and others making up the nine per cent balance.

Alumina exports reflect global aluminium market conditions with around 98 per cent of the world's alumina being used for aluminium production. Alumina feedstock is the largest single component of the cash cost of producing primary aluminium metal. Some two tonnes of alumina are required to produce one tonne of aluminium and the industry is very competitive, with the world's major aluminium-producing companies also playing key roles in both bauxite mining and alumina refining.

Western Australia currently has two alumina producers, Alcoa World Alumina Australia and Worsley Alumina Pty Ltd (BHP Billiton Limited 86 per cent, Japan Alumina Association (Australia) Pty Ltd ten per cent and Sojitz Alumina Pty Ltd four per cent). Both producers' refineries are located within close proximity to their bauxite mines and shipping facilities which allows economical processing of relatively low-grade bauxite.

Alcoa mines bauxite at their Huntly (the biggest bauxite mine in the world) and Willowdale mines south of Perth and extracts alumina at the Kwinana, Pinjarra and Wagerup refineries.

The 657 000-tonne Pinjarra refinery capacity upgrade to 4.2 million tonnes per annum was commissioned in the last quarter of 2005–06 at a cost of US\$510 million.

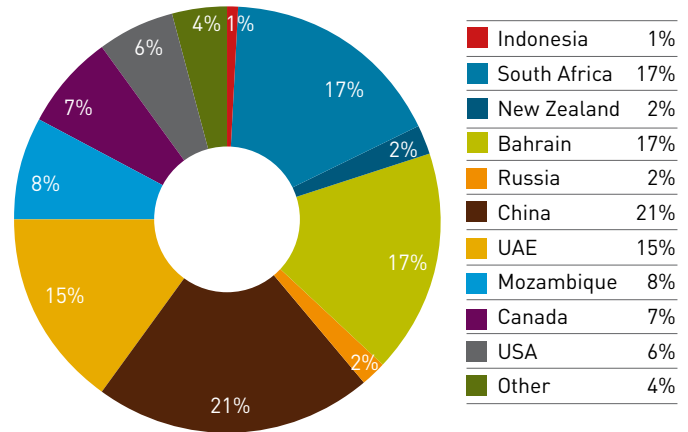


Figure 37 | **Alumina Exports**  
Total Value \$4.66 billion Source: DoIR

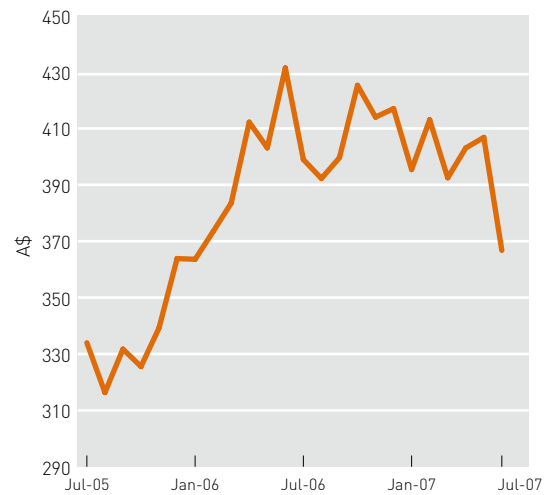


Figure 38 | **Alumina Price A\$/tonne** Source: ABS

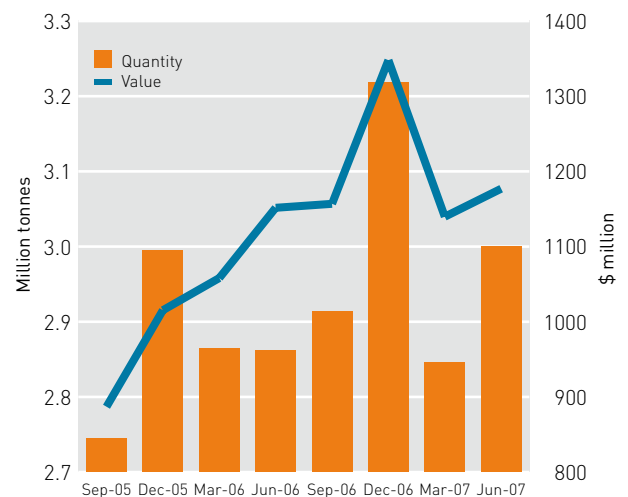


Figure 39 | **Alumina Quantity and Value by Quarter** Source: DoIR

Ramp-up of production continued through to the end of 2006, increasing overall output for the current period.

In September 2006 government approval was given for the construction of a third production unit at the Wagerup refinery to increase alumina capacity from 2.6 million tonnes per annum to 4.7. It is estimated that the project will cost in the vicinity of \$1.5 billion. Approval for the project's expansion is subject to 42 conditions, including that Alcoa funds air quality testing and health surveys in addition to purchasing land. The project is expected to create 1500 jobs during construction and 260 permanent jobs.

In April 2007 Alcoa unveiled their 'Carbon Capture' system developed by their Technology Delivery Group in Kwinana. The technology, which has the potential to revolutionise greenhouse emissions in the aluminium industry, locks up CO<sub>2</sub> in a greenhouse sink. When operating at full capacity, the Kwinana carbonation plant will treat all residue produced by the refinery, reducing CO<sub>2</sub> emissions by 70 000 tonnes annually. Alcoa plans to deploy the technology across its operations in Australia and worldwide. In Australia alone, this technology could potentially save 300 000 tonnes of CO<sub>2</sub> a year being released into the atmosphere (the equivalent of removing 75 000 cars).

Worsley's bauxite mine is located approximately 120 kilometres southeast of Perth at Boddington and the crushed ore is transported to the refinery via overland conveyor to Worsley near Collie. Alumina is then carted by rail and exported through the Port of Bunbury.

Federal Government approval has been granted for Worsley's Efficiency and Growth expansion project and a feasibility study for the project is expected to be completed by the end of 2007 when a formal submission will be made to the joint venture partners. The project's aim is to expand existing mining, refinery and ship-loading operations to increase production from 3.5 to 4.4 million tonnes per year. The study will consider investigations and trials of new process technologies, improvements in water and energy efficiencies as well as the availability of labour and materials. Cost estimates for the project are around

\$900 million however final costs will depend upon the direction taken by the joint venture partners.

Norwegian giant Norsk Hydro (43 per cent owned by the Norwegian Government) signed a Memorandum of Understanding with United Minerals Corporation (UMC) to form a joint venture to assess the feasibility of developing an integrated bauxite mine and alumina refinery in the Kimberley region of Western Australia. The joint venture would be with Hydro Aluminium AS (a wholly owned subsidiary of Norsk Hydro) who is one of the world's largest integrated aluminium producers (75 per cent share) and UMC (25 per cent share).

Norsk already has a major presence in Western Australia through Yara International, a partner in the Burrup Fertiliser plant near Karratha. UMC holds more than 7000 square kilometres in the region, including Aldoga's tenements which are estimated to contain at least 40 million tonnes of bauxite.

Aluminium demand is strong worldwide and Chinese consumption continues to be the driver of global demand. Driven by strong growth in building construction, electrical power grids and consumer durables, aluminium consumption in China increased by around 47 per cent (year on year in the first quarter of 2007).

Being about 40 per cent lighter than steel and consumers seeking lighter, more economical cars, the transport sector has embraced aluminium. Experts predict that by 2009 more cylinder blocks, wheels and cylinder heads will shift to aluminium. Fourteen per cent of China's consumption of aluminium is linked to the transport sector and for 2008 the National Development and Reform Commission has set a production target of 10 million motor vehicles (up from 8 million in 2006). Currently, an average car contains around 125 kilograms of aluminium.

With significant production increases, downward pressure can be expected on alumina prices. There is a similar story for aluminium which has seen low stocks in 2007 and very high prices. Continued production increases though may place a ceiling on further price increases with major impetus for consumption growth emanating chiefly from China.

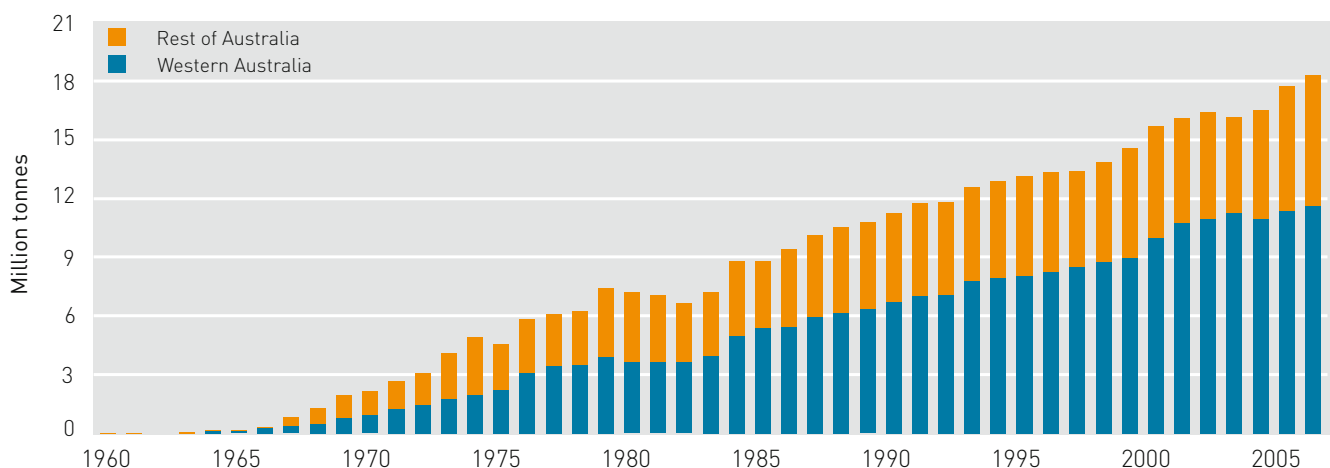


Figure 40 | Alumina Quantity Source: DoIR and ABARE

## 2.6 GOLD

In 2006–07 the gold industry, at \$4.1 billion, ranked as the fifth-largest commodity sector in Western Australia, accounting for eight per cent of the State’s total mineral and petroleum sales. On a national scale, in 2006–07, Western Australia accounted for around 62 per cent of Australia’s gold production. Statistics show that Australia’s gold production remained almost static at 251 tonnes (8 million ounces) in 2006–07 compared to 2005–06.

Western Australia’s gold sales in 2006–07 amounted to 5.04 million ounces (157 tonnes), representing a six per cent decrease compared with the previous year. Yet again, wet weather caused by seasonal cyclonic activity, lower tonnages of ore treated and lower average head grades had the effect of reduced gold output.

However, higher gold prices have counteracted reductions in output and have helped boost the value of the State’s gold sales to \$4.09 billion, up ten per cent over 2005–06.

In 2006–07, the average international price of gold was US\$638 per ounce, up 21 per cent compared to the previous financial year. The gold price has remained in the spotlight following its upward trend in the last half of 2005, peaking in May 2006 at US\$725 per ounce.

In mid-May 2006, gold hit an all-time record in Australian dollar terms of \$933.20 per ounce. In Australian dollar currency terms, the average gold price was 15 per cent higher, up from an average of \$705 per ounce in 2005–06 to \$813 per ounce in 2006–07.

Analysts predict that a jump in investor interest in 2007–08, triggered by geopolitical or global economic events, could see the gold price move towards the highs experienced in May 2006 and if this continues through 2008, the possibility of new price records could be set.

More and more of the world’s major gold miners are buying out their hedge books in the expectation that the gold price will continue to strengthen. In July 2007 Newmont closed out its last remaining hedging contracts allowing the company to claim it is now the world’s largest un-hedged gold producer. Hedging, the practice of locking in future revenues by promising to sell a fixed volume of un-mined gold at a certain point in the future at an agreed price is no longer the preferred option for most of the world’s major gold miners. It does provide a degree of certainty and some banks insist on sufficient hedging to cover loans taken out to develop new operations. Opponents to the practice argue that it weighs down the gold price by suggesting the miner believes future gold prices will fall and robs miners of their appeal to investors seeking direct exposure to the gold price.

Western Australia’s ten largest projects accounted for a little over 70 per cent of the State’s gold output in 2006–07. These projects comprised:

- Golden Mile (Kalgoorlie Consolidated Gold Mines Pty Ltd (KCGM) – 20.24 tonnes
- Telfer Gold (Newcrest Mining Limited) – 17.3 tonnes
- Sunrise Dam (AngloGold Ltd) – 16.8 tonnes

- St Ives (Gold Fields Ltd) – 15.1 tonnes
- Jundee Nimary (Newmont Mining Corp) – 9.3 tonnes
- Plutonic (Barrick Gold Corp) – 7 tonnes
- Granny Smith (Placer Dome Inc) – 6.9 tonnes
- Agnew (Gold Fields Ltd) – 6.7 tonnes
- Kanowna Belle (Placer Dome Inc) – 6.7 tonnes
- Marvel Loch (St Barbara Limited) – 5.2 tonnes

Exports of gold from Western Australia totalled \$10.43 billion for 2006–07 however only 39 per cent of this amount (\$4.1 billion) can be attributed to being sourced from Western Australian mines (see Gold Export Update 2006–07 in this section). India topped the export destinations again with 44 per cent followed by the United Kingdom with 18 per cent, Switzerland nine per cent, Vietnam seven per cent, Thailand and the United Arab Emirates six per cent with others making up the balance. Although the United Kingdom is credited with taking 18 per cent of exports in 2006–07, it should be noted that with London having a central role in the gold market, it is often used as a shipping destination to be on-sold from London accounts.

Data published by GFMS revealed that global mine production declined approximately 79 tonnes or three per cent in the calendar year 2006 compared to the previous year with losses in the top five producers, South Africa, Australia, Indonesia, the United States and Canada. This leaves global production at a ten-year low. Latin America was the only region to return a rise of 35 tonnes, or seven per cent.

In terms of the State’s gold production outlook, there were a host of gold projects looking at re-opening and some current producers looking to expand, as well as new projects planned, due to the higher gold price. However, with the Australian dollar strengthening against the US dollar in the early part of 2007 and breaking through the 88 cent barrier to reach .8867 in July this year (an 18-year high) not all of these projects are proceeding in the near-term. The two-year price graph demonstrates the widening gap between US Dollar prices and Australian dollar prices.

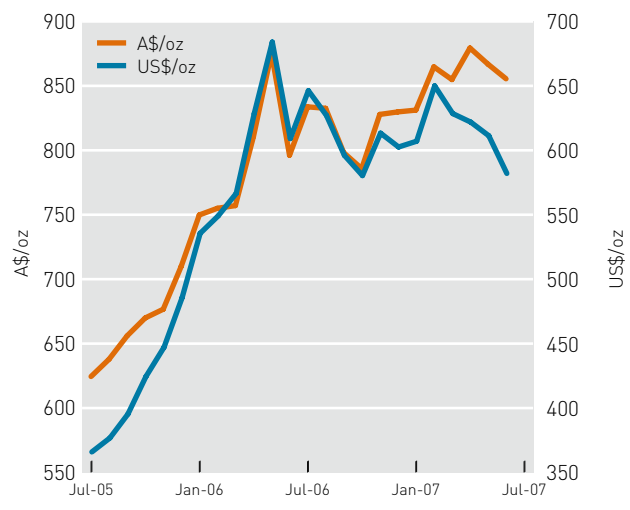


Figure 41 | Gold Price Source: Perth Mint and London Fix



## GOLD EXPORT UPDATE 2006-07

The Australia Bureau of Statistics (ABS) released trade data that indicated a significant rise in Western Australian gold exports. However, this apparent increase in gold exports from Western Australia has been due to a restructuring of Australia's gold refining industry.

In October 2002, AGR Matthey was formed. This is a partnership between Johnson Matthey (Aust) in Victoria, WA Mint (The Perth Mint) and the Australian Gold Alliance. As a result of the merger, all Australian gold is now refined in Western Australia. The Victorian refinery still refines silver and jewellery products.

Gold export data published by the ABS from Western Australia must therefore be interpreted with some caution. It includes gold produced in other States and Territories, in addition to production from overseas operations, namely Papua New Guinea and Asia, which is refined and exported from Western Australia. This export figure is therefore larger than Western Australia's own level of gold production from its own mines.

The ABS estimates that gold exports from Western Australia in 2006-07 amounted to approximately \$10.43 billion. Approximately 39 per cent or \$4.1 billion was gold produced in Western Australia. The remaining 61 per cent (approximately \$6.33 billion) can be attributed to gold refined and exported from Western Australia but produced from mining operations in other States, Territories and overseas.

Overseas imported gold also includes scrap which is refined in Western Australia and exported.

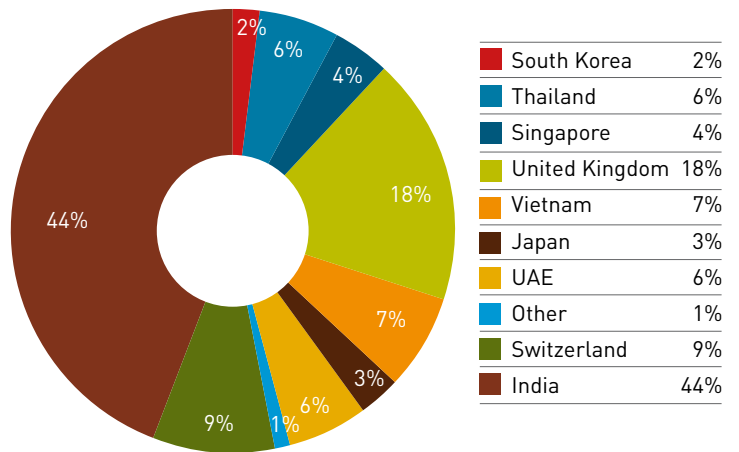


Figure 42 **Gold Exports**  
**Total Value \$10.43 billion** Source: DoIR and ABS  
*Note: Includes gold refined/processed and exported from Western Australia but produced from mining operations in other States, Territories and overseas.*

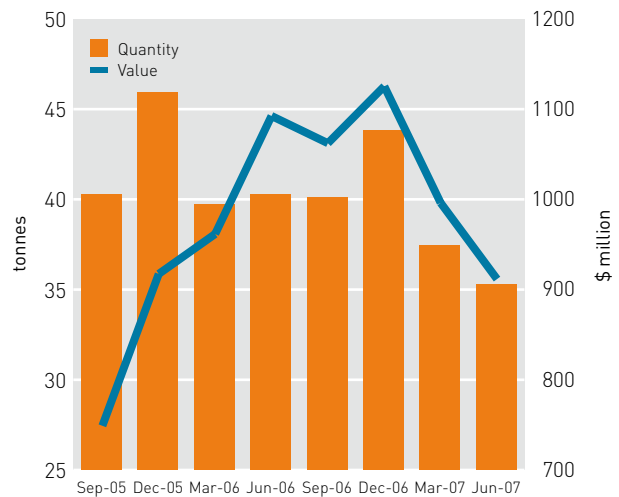


Figure 43 **Gold Quantity and Value by Quarter** Source: DoIR

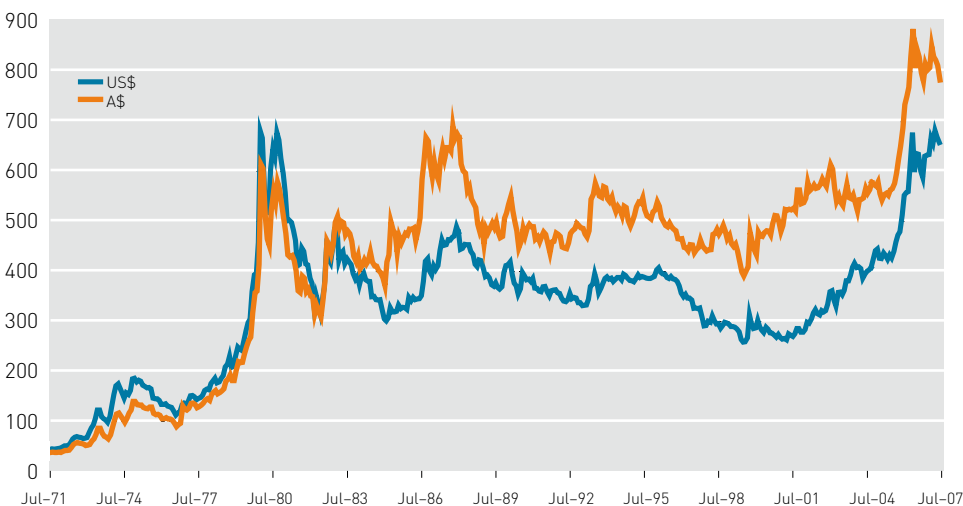


Figure 44 **Historic Gold Price US\$/A\$ per ounce** Source: World Gold Council

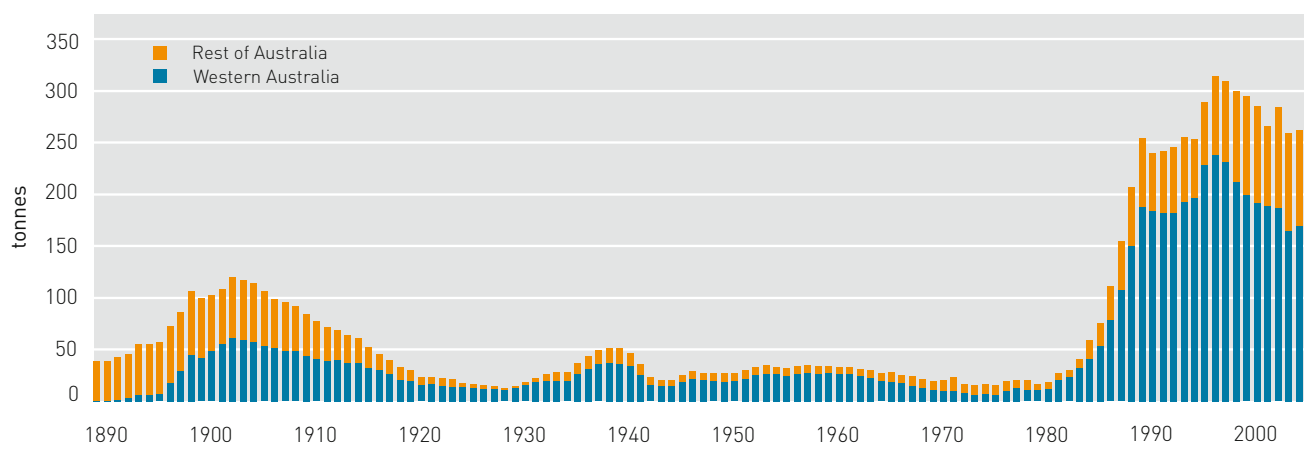


Figure 45 | **Gold Production** Source: DoIR and ABARE

Listed below are some of the projects still proceeding with either development or expansions:

- Newmont Mining Corporation in Joint Venture with Anglo Gold Ashanti Limited's expansion of the Boddington gold mine (Wandoo South and Wandoo North). Boddington is located 130 kilometres southeast of Perth. Production will be up to 600 000 ounces per annum of gold and about 20 000 tonnes per annum of copper in concentrates over a 15-year life. Initial production is not expected until late 2008 or early 2009.
- Kalgoorlie Super Pit – Kalgoorlie Consolidated Gold Mines Pty Ltd (KCGM) plans to extend the life of its open-cut mine by five years to 2017 with the Golden Pike Cutback. KCGM is progressing through the government approval process. The Super Pit is located 3 kilometres southeast of the town of Kalgoorlie and is the largest gold open pit operation in Australia. What was once the Golden Mile was named the Fimiston Open Pit, which in turn has become known as the Super Pit. The now famous landmark will eventually stretch 3.8 kilometres in length, be 1.35 kilometres wide and go down to a depth of more than 500 metres.
- Ramelius Resources Limited's Wattle Dam commenced mining operations in 2006 as an initial six-month operation however after continual drill success, which has expanded the resource, the project is now open-ended. After one of the richest gold intersections ever made in Western Australia, a diamond drilling program is planned to commence around September 2007 and will continue as the deposit is drilled out as a precursor to underground development. Wattle Dam is located 25 kilometres west of Kambalda.
- Integra Mining Limited has published promising results of its pre-feasibility financial outcomes on its Aldiss-Randalls deposit 130 kilometres east of Kalgoorlie. The

modelling indicates a four-year mine-life producing up to 115 000 ounces per annum however a decision to carry out more exploration for a fifth-year mine-life has been made.

- In May 2006, revised mineral resource estimates announced by Saracen Mineral Holdings Limited at their Carosue Dam project have revealed significant increases in resources. In August 2007 Saracen were progressing the project through a definitive feasibility study. Carosue Dam is located 110 kilometres northeast of Kalgoorlie.
- St Barbara Limited approved the development and mining of Gwalia Deeps in February 2007 and forecast reserves will sustain production for at least eight years. The Gwalia Deeps project is located four kilometres southeast of Leonora. Gold production will be at the initial rate of 100 000 ounces per annum in 2008–09 building up to 200 000 ounces during 2009–10.

A feasibility study into St Barbara's other project at Leonora, Tarmoola open pit, has identified that at current gold prices and forecast operating costs the project is not commercially viable on its own.

- In 2005 Mercator Gold PLC bought the Bluebird mine from St Barbara Mines NL. Bluebird is located around 15 kilometres southwest of the town of Meekatharra. Mercator has now commenced open pit mining at the Surprise pit and this will be followed with other deposits providing plant feed for the balance of the first four years of operation. Commissioning of the mill is expected to be completed by the end of September 2007 and it is expected to produce around 120 000 ounces of gold in the first year.
- Avoca Resources Limited is developing their Trident gold project within the historical mining centre of Higginsville which lies midway between the world-

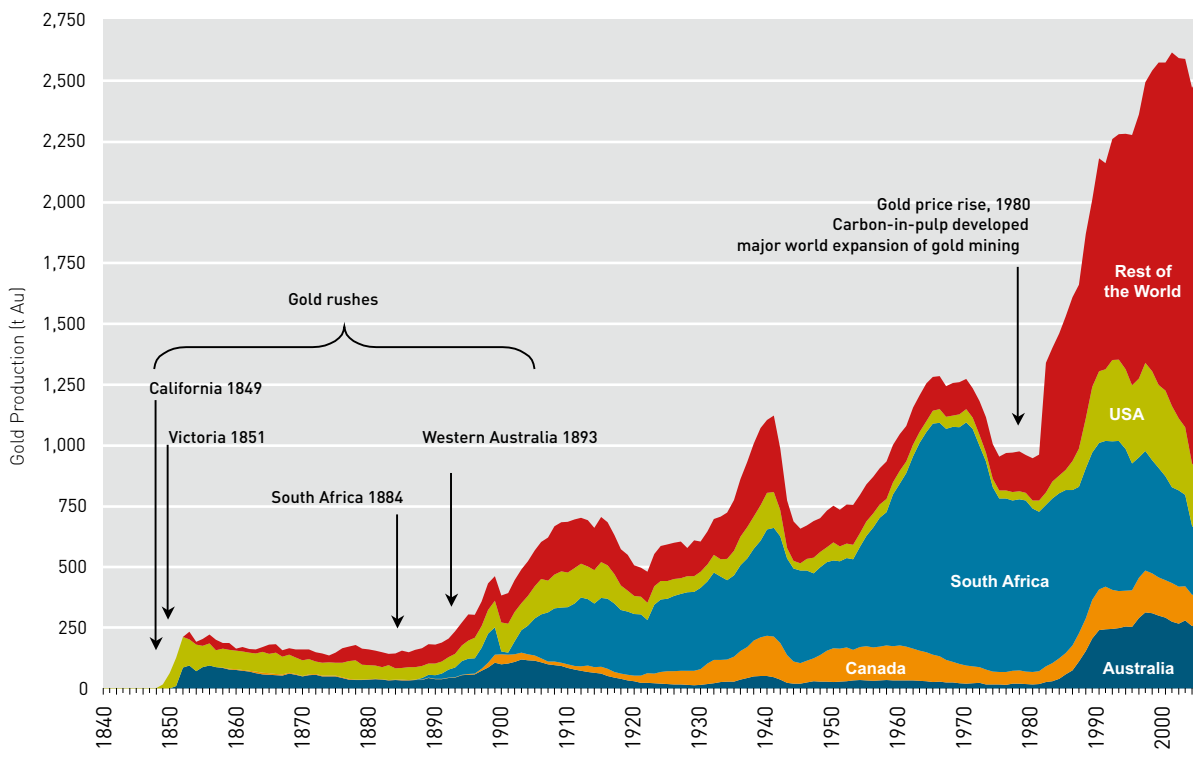


Figure 46 | **World Gold Production 1840–2005**

Source Mudd, GM, Global trends in gold mining: towards quantifying environmental and resource sustainability

class mines of St Ives and Norseman in the Eastern Goldfields of Western Australia. With the new high grade ore discovery of Apollo, adjacent to Trident, it is expected to provide a ten-year plus mine-life. Rehabilitation work of the old underground workings of Poseidon South is nearing completion and production is expected to start in the second half of 2007 at the annual rate of 160 000 to 190 000 ounces.

- Monarch Gold Mining Company has given the go ahead for its Davyhurst gold project located 120 kilometres northwest of Kalgoorlie and poured its first gold in the third quarter of 2007. Monarch will add ore from the company's Mt Ida project in November 2007 which will increase production to 9 to 10 thousand ounces per month. Monarch are also focusing on another two potential production centres, Minjar and Bellevue.
- Joint venture partners La Mancha Resources Inc, operator (51 per cent) and Dioro Exploration NL (49 per cent) are developing the Mungari East (Frogs Leg) underground gold mine. The preliminary development work to be carried out prior to September 2007, when the feasibility study is expected to be completed, will avoid the delay of mine operations scheduled to start in the first half of 2008. The project is located 19 kilometres west of Kalgoorlie.

The Frogs Legs first open cut mining phase commenced in 2004 with operations finishing in November 2005 generating 117 thousand ounces. Ore was toll-treated through the Higginsville Greenfields plant (29 kilometres by road).

- The Tropicana gold project has moved to a pre-feasibility study phase which is expected to be completed mid-2008. Tropicana, located 400 kilometres northeast of Kalgoorlie is a joint venture between AngloGold Ashanti Ltd (70 per cent) and Independence Group NL (30 per cent). The discoveries at Tropicana are reported to have multi-million ounce potential.
- Tanami Gold started open pit operations at its Coyote mine in mid-2006 with a projected production target of 60 000 ounces for the year and a mine-life of around five years. However, due to delays in the construction and commissioning of the treatment plant and some bad weather in the early part of 2007, the mine was only operational for half of the year. Coyote is located 250 kilometres southeast of Halls Creek.
- A1 Minerals Limited is well advanced into a feasibility study on their Brightstar project in the Laverton district. The area is host to a number of world-class gold deposits including Sunrise Dam, Wallaby and the Granny Smith ore bodies. Should the project proceed, it is likely to lead off with the Beta area of the project as it has all necessary regulatory approvals already in place.
- Regal Resources Limited commenced mining operations at its Menzies gold project. Milling arrangements were initially delayed and alternative arrangements have been made with transport commencing early in the June quarter. The project is projected to produce around 24 thousand ounces of gold over a 16-month period.

## 2.7 BASE METALS

The overall value of the Western Australian base metals sector rose by 71 per cent to reach \$1.68 billion during 2006–07. The increase was primarily due to very strong international prices for base metals as well as overall increased production levels. On average, throughout 2006–07, in Australian dollar terms, zinc rose an amazing 64 per cent, lead 50 per cent and copper increased 33 per cent. In value terms, this puts base metals ahead of heavy mineral sands for the first time.

The overall largest producer of base metals by value (around 48 per cent of the total value) in Western Australia is Oxiana Limited with its Golden Grove project located approximately 450 kilometres northeast of Perth. Golden Grove consists of the Scuddles and Gossan Hill zinc and copper mines and the Scuddles concentrator. Oxiana acquired Golden Grove from the Newmont Mining Corporation in July 2005. The Golden Grove project produces zinc concentrate and copper concentrate which also contains silver, gold and lead. Product is exported to China, South Korea, Thailand and India.

The reopening of Teck Cominco–Xstrata’s 50:50 Pillara’s lead–zinc underground operation in the Kimberley region saw production commence early in 2007 with first shipments in the June quarter. Located 25 kilometres southeast of Fitzroy Crossing, the mine has an anticipated life of four years at an annual production rate of 70 to 80 000 tonnes of zinc and 15 000 tonnes of lead in concentrates.

### COPPER

Copper production in Western Australia may be split into three categories comprising copper concentrate, copper cathode and copper by-product (mainly from nickel mining). During 2006–07, the total quantity of copper sold increased by around 38 per cent to 112 280 tonnes whilst the value rose 70 per cent to \$953 million. On average during 2006–07 copper prices increased 33 per cent in Australian dollar terms. Copper prices reached record levels of US\$3.99 (A\$4.84) per pound in May 2006.

Aditya Birla Minerals Ltd operates the Nifty copper mine located in the Great Sandy Desert region of the Pilbara, 350 kilometres east of Port Hedland and approximately 1250 kilometres north of Perth. Nifty currently has a capacity of 25 000 tonnes per annum of copper cathode from their open pit operation which is under contract of sale to Glencore. Although open pit mining operations ceased in mid-2006, copper extraction, heap leaching is expected to continue for a further five years.

Aditya Birla also has a large copper sulphide resource estimated to be around 1.9 million tonnes of copper equivalent. The commissioning of their sulphide operation, an underground mine with a copper concentrate plant, commenced in early 2007 and will ramp-up to full capacity through 2007. The mine will have a capacity of 2.3 million tonnes per year. During the 2006–07 financial year Aditya Birla reported producing a total of 41 465 tonnes of copper. The concentrate product is trucked to Port Hedland for shipping (under contract) to Hindalco Copper’s Dahej smelting and refining facilities in India.

Straits Resources Limited operates the Whim Creek and Mons Cupri copper cathode projects located midway between Karratha and Port Hedland. After mining, oxide copper ore is trucked to a processing facility located midway between the two ore bodies. The lengthy process of heap leaching (which can take from six to twelve months to recover most of the copper from the oxide ore), then solvent extraction and electrowinning follows (taking around a week). During the 2006–07 period, Straits produced a total 15 162 tonnes of copper cathode; however not all of this production is reported to DoIR, as the Whim Creek tenements are not covered by the *Mining Act 1978*.

Newcrest Mining Limited’s Telfer gold project, 310 kilometres northeast of Newman, reported producing a total of 27 820 tonnes of copper in concentrate for the 2006–07 period.

Golden Grove reported producing 18 529 tonnes of copper concentrate for the period whilst Fox Resources Limited’s Whundo copper mine produced 5803 tonnes of copper. Fox operates the Radio Hill project (located just 45 kilometres south of the town of Karratha) where it produces a nickel and copper concentrate which is exported to a leading Chinese nickel producer, Jinchuan Group Limited.

Of the fourteen nickel operations which produce copper as a by-product in concentrate, Sally Malay Mining Corporation’s Sally Malay project contributed around 46 per cent of the total 7600 tonnes for the 2006–07 financial year.

### LEAD

As with other base metals, lead prices surged, trading for short periods at over US\$1.20 per pound during June 2007 to reach an average for 2006–07 of US\$0.77 per pound an increase (in US dollar terms) of 59 per cent. In August 2007 the LME price for lead was still going strongly trading at times at over US\$1.50 per pound.

The only current stand-alone lead producer in Western Australia was commissioned in 2005 and officially opened in September 2005. Ivernia’s Magellan lead operation, located 30 kilometres west of Wiluna and 900 kilometres northeast of Perth, is considered amongst the top five lead-producing mines in the world (when in full production). It has a mine-life of approximately ten years.

Temporary suspension of operations at the Magellan mine in early April 2007 resulted from problems associated with lead contamination. Shipments are scheduled to recommence pending regulatory approval for containerised shipments. The bulk of Magellan’s shipments have been made to smelters in China, with Belgium, South Korea and Thailand receiving smaller quantities.

Golden Grove’s reported production of lead for the 2006–07 period was 9673 tonnes in concentrate.

With the re-opening of the Lennard Shelf (Pillara mine) operations in the Kimberley, there are now two mines producing lead in concentrate as a by-product. For the 2006–07 period Pillara produced around 4800 tonnes of lead.

## ZINC

Zinc prices were trading at around US\$2.00 per pound at the end of 2006 and eased back to around US\$1.50 per pound by the end of June 2007, striking an average for the year of US\$1.67 per pound. This average price (in US dollar terms) represented an increase of some 73 per cent over the previous year.

Golden Grove, together with the recently re-opened Lennard Shelf project, currently produce all of Western Australia's zinc in concentrate. Oxiana reported production of 129 276 tonnes for 2006–07. All of Golden Grove's zinc is sold to smelters in Asia under long-term supply contracts.

Fox Resources Limited owns the Whundo copper mine (located within the Radio Hill project) and has operated intermittently since 1911. In the June 2007 quarter Fox negotiated a zinc off-take agreement with SinoSteel Australia for zinc concentrate from their West Whundo deposit to be shipped to Huludao, China's largest zinc producer.

The reopening of Teck Cominco–Xstrata's 50:50 Pillara's lead–zinc underground operation in the Kimberley region saw production commence early in 2007 with first shipments in the June quarter. Located 25 kilometres southeast of Fitzroy Crossing, the mine has an anticipated annual production rate of 70 to 80 000 tonnes of zinc and 15 000 tonnes of lead in concentrates. Production of zinc from Pillara for 2006–07 was around 12 900 tonnes.

## 2.8 MINERAL SANDS

Western Australia remains the nation's dominant producer of heavy mineral sands accounting for over 80 per cent by total value sold in 2006–07. During 2006–07, the value of Western Australian mineral sands increased by nearly eight per cent (\$932 million) when compared with 2005–06. Quantities sold were also up with the exception of leucoxene which fell by around 30 per cent and zircon was down six per cent. By tonnage, ilmenite rose 57 per cent, synthetic rutile was up six per cent and rutile increased by 36 per cent.

In the past, export markets for Western Australian heavy mineral sands have been very diverse however for the 2006–07 period, China has taken the lion's share with 22 per cent of all product exported. The rest of Asia took 16 per cent, the United States accounting for 13 per cent, Europe nine per cent, Japan eight per cent, South Korea, Taiwan and Spain all took five per cent and other countries made up the balance.

Prices received by Australian producers of heavy mineral sands during 2006–07 were mixed. Prices for titanium dioxide (TiO<sub>2</sub>) pigment fell on average by just under three per cent, ilmenite prices on the other hand increased ten per cent, leucoxene prices fell 15 per cent, rutile fell by two per cent and zircon prices grew by four per cent.

Although Australia is experiencing the effects of a strengthening Australian dollar against the US dollar, other major currencies including the euro and the British pound have risen to a similar extent. In contrast, South Africa, an important mineral sand producing country, has seen the rand weaken significantly against the US dollar since the beginning of 2006.

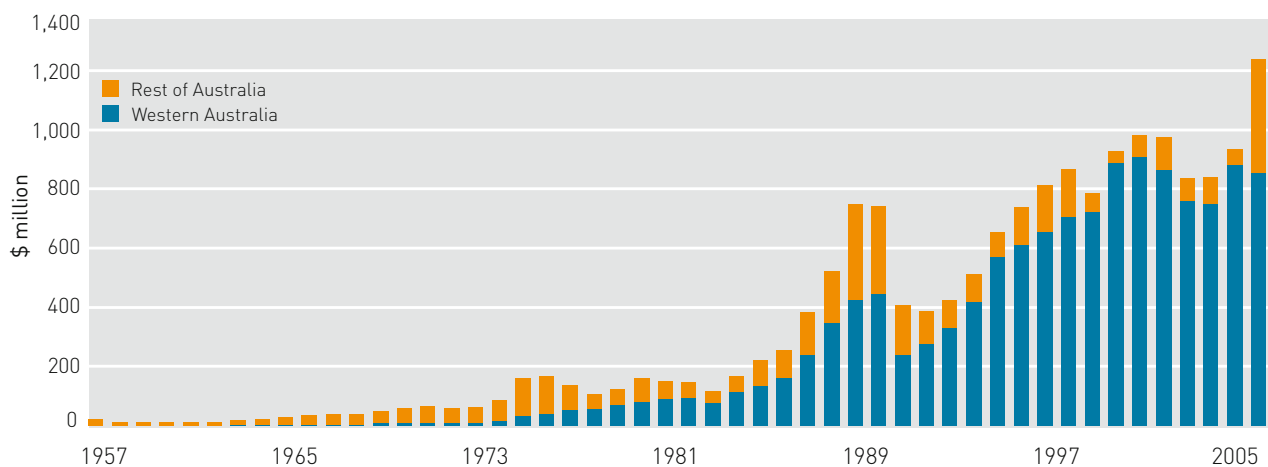


Figure 47 | **Heavy Mineral Sands Value of Production**  
Includes Ilmenite, Leucoxene, Upgraded Ilmenite, Rutile, Zircon and Monazite. Source: DoIR and ABARE

Western Australia is dominated by two major producers, Iluka Resources Ltd and the Tiwest Joint Venture, which is a joint venture between Tronox Western Australia Pty Ltd, a subsidiary of Tronox Incorporated, and the subsidiaries of Australian-based Ticor Resources Pty Ltd. These two producers account for around 90 per cent (by value) of all Western Australian heavy mineral sands sold in 2006–07.

Iluka's operations include Yoganup West and the Wagerup mines as well as two dry separation plants and a synthetic rutile processing plant located at North Capel and Capel in the southwest of the State. Mining at Yoganup Extended ceased in early 2007 and the site is undergoing rehabilitation. Capel is about 200 kilometres south of Perth and processed product is shipped through the nearby Port of Bunbury.

Narngulu is the processing centre for Iluka's operations in the Mid West and is located on the outskirts of Geraldton, 410 kilometres north of Perth. Titanium minerals and zircon from the Eneabba (260 kilometres north of Perth) and Gingin (80 kilometres north of Perth) mine sites are processed at Narngulu before they are exported through the Geraldton Port. The processing facilities consist of a dry separation plant, zircon finishing plant and a synthetic rutile processing plant.

Government approvals were given for Iluka to develop two new mine sites in 2006 and one in 2007. Cataby approval was received in April and Waroona in August 2006.

- Cataby is located approximately 150 kilometres north of Perth, covers a mineral resource approximately 25 kilometres long and commenced mining in 2007. It has an expected mine-life of five years with 13 pits being mined progressively by dry mining techniques using a combination of scrapers, front-end loaders, excavators and haul trucks.

- The Cloverdale project (approved in March 2007) adjacent to the facilities at Yoganup West, commenced construction in late March 2007 and will start mining later in 2007 and is expected to finish some time in 2008.
- The new Waroona mine commenced dry mining early in 2007 and is located approximately 140 kilometres south of Perth, covering approximately 180 hectares.

In August 2007 Iluka announced that after more than 50 years association with mining in the South West, the company will be winding up its operations in the area in 2014. This comes 12 years ahead of schedule. This announcement comes after decisions to close businesses in Florida and Georgia. Iluka will maintain its operations in the Mid West and focus on the Murray Basin in Victoria and the Eucla Basin in South Australia.

TiWest's Cooljarloo mine, is situated approximately 170 kilometres north of Perth. Ore is processed through concentrators before being transported in specially designed road trains from the mine site at Cooljarloo to the dry mill, 110 kilometres to the south, at Chandala. The Chandala complex includes three major plants – a dry mill, which separates the minerals, a synthetic rutile plant, which upgrades ilmenite into high quality titanium dioxide pigment feedstock, and a waste management plant. Using technology developed in Western Australia – the Improved Becher Process – Tiwest upgrades the titanium dioxide content in ilmenite from an average 61 per cent to at least 93 per cent in synthetic rutile.

Not all synthetic rutile from Chandala is exported. A large quantity is railed to Tiwest's Kwinana pigment plant where it is transformed into pure white pigment, TiO<sub>2</sub>, which is used as a commercial colouring agent and coating material. The Kwinana facility is a cogeneration plant,

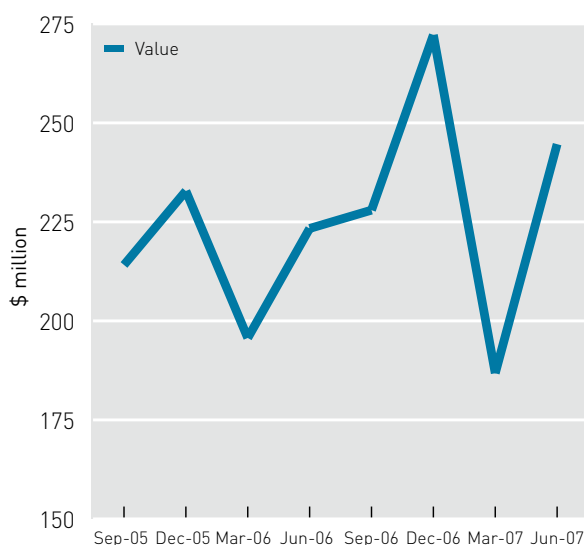


Figure 48 | **Heavy Mineral Sands Value by Quarter** Source: DoIR

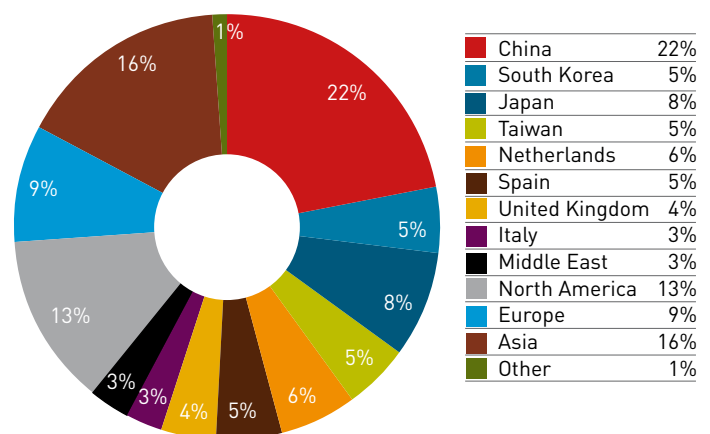


Figure 49 | **Heavy Mineral Sands Exports Total Value \$1.41 billion** Source: DoIR

Note: Exports include titanium dioxide and product sourced from other States and processed in Western Australia

where a gas turbine generates electricity and the exhaust gases, which would in the past have been vented into the atmosphere, are used to raise steam for use in the pigment plant. The plant generates all of Tiwest's power requirements, plus surplus electricity for the South West Interconnecting Grid.

Bemax Resources Limited through its wholly owned subsidiaries that make up the Cable Sands Group is the next largest operator with its Ludlow and Tutanup South mines. Cable Sands' Bunbury Mineral Separation Plant (MSP) treats feedstock from the company's own mines as well as on a toll treatment basis for a number of customers. During 2005 the MSP underwent a \$6-million upgrade to allow it to simultaneously process feedstock from both its Western Australian and Murray Basin operations in South Australia.

Doral Mineral Sands Pty Ltd is the smallest of the Western Australian mineral sands producers located at Dardanup and Picton. The company is a wholly owned subsidiary of Perth-based Doral Mineral Industries Limited, itself an unlisted public company owned by Iwatani International Corporation of Japan. Ore at Dardanup is concentrated and trucked nine kilometres to the continuously operated Picton dry separation plant. Product is then exported from the nearby Bunbury Port.

It should be noted that not all heavy mineral sands mined comes under the *Mining Act 1978*. Some product is mined from land granted to private individuals prior to 1899 and as such is not reported to the Department.

## 2.9 DIAMONDS

Rio Tinto's Argyle mine, 112 kilometres south-southwest of Kununurra, accounts for the bulk of diamond production in Western Australia and in 2006-07 produced 24.24 million carats.

Argyle commenced mining its main ore body in 1985 and since that time has produced over 678 million carats of diamonds worth a combined US\$11 billion (A\$14.3 billion). The open pit resource is in decline and projected to be exhausted by around 2008 when plans are in place to go underground. In December 2005 Rio Tinto announced its decision to develop the underground project at the Argyle diamond mine with an additional US\$150 million to be spent on a related open pit cutback. The \$760 million construction of an underground block cave operation is currently underway to extend the life of the operation to 2018. The semi-automatic block cave will be one of the world's most sophisticated mines, using remotely operated machinery.

Variability in feed grade and production rates will continue as the open pit operation approaches the end of its life and transitions to the underground operation. Cyclonic conditions also hampered production in the March quarter of 2007.

The Argyle mine is famous for its pink diamonds and accounts for around 90 per cent of the world's production of this type of diamond. It also accounts for the majority of natural-coloured diamonds in the market. The colour range includes white, champagne and pink. Argyle

production consists of five per cent gem and 70 per cent near gem with the remaining 25 per cent of the volume being industrial diamonds. The entire gem and near-gem diamonds are polished and account for more than 95 per cent of the value of Argyle's rough diamond sales.

The Kimberley Diamond Company with its Ellendale mine, 100 kilometres east of the coastal town of Derby (2000 kilometres north of Perth in the Kimberley region), is the State's only other producing diamond mine. During 2006-07 the Ellendale mine produced around 378 000 carats with sales of around 363 600 carats achieving an averaged price of US\$134 per carat (A\$171 per carat) realising revenue of A\$62.3 million, almost double that for the previous year.

Ellendale produces predominantly gem and near-gem quality diamonds, including some fancy yellow stones. Since mining began in mid-2002 the company has recovered some 695 000 carats of diamonds generating a sales revenue of over \$147 million. Expansions and upgrades will increase Ellendale's total processing capacity to more than 8.3 million tonnes per annum, from mid-2006 raising the company's annual production to more than 600 000 carats per annum. Delays in the construction and commissioning of the upgrade of the Ellendale 9 East Plant limited throughput in 2006-07 and significantly reduced carat production and sales.

Although wet weather from cyclones did not impinge on operations at Ellendale, access to the Gibb River Road (the only access road to the mine site) was restricted earlier in 2007 to vehicles weighing under three tonnes. This restriction adversely affected construction, delaying the arrival of concrete trucks vital to the expansions. These delays limited throughput and resulted in significantly reduced carat production and sales.

In July 2007 Kimberley Diamonds announced an increase to 1.6 million carats of rough diamonds at its Ellendale 9 project, 41 per cent more than previously estimated a year earlier. This area of the mine has the highest value diamonds which have been averaging US\$370 per carat.

Gem diamonds share the podium with gold as a luxury commodity, principally in diamond rings to mark engagements and the special anniversaries of life and in other jewellery. Industrial diamonds have an important role as abrasives in sanding discs, circular saws, drilling bits and other machining processes.



## 2.10 OTHER MINERALS

### COAL

All of Western Australia's coal supplies are sold domestically from Collie coal mines to Verve Energy and other large local energy users, mainly in the mineral-processing sector. Collie is located 50 kilometres inland from the coastal city of Bunbury. In 2006–07, the quantity and value of coal dropped by 10 per cent to 6.02 million tonnes and \$267 million. This was a result of lower coal use due to the closure in April 2007 of units A and B of the Muja power station. This reduced generator capacity has been taken up by other generators which are gas-fired and to a lesser extent powered by wind.

About 90 per cent of Collie coal is used as thermal coal, mostly in power stations and the majority of the remainder is used metallurgically by the mineral sands industry to reduce ilmenite to synthetic rutile. A small quantity is used to reduce silica sand to silicon metal.

In August 2005, Wesfarmers Premier Coal Limited was successful in its bid to supply Western Power Corporation's (now Verve Energy) long-term coal requirements from 2010 to 2030 for its coal-fired power stations at Collie in Western Australia. This contract will underpin the long-term future of the Premier coal mine for Wesfarmers.

The other Western Australian coal producer, Griffin Coal, commenced construction early in 2006 on the State's first privately funded, owned and operated coal-fired power station, Bluewaters I. It will take approximately 30 months to build. All Government, community, environmental and regulatory approvals for the \$400-million, 208-megawatt project have been received. Griffin has signed a contract to supply 150 million watts for the \$1.8 billion Boddington gold mine.

Western Power Corporation commenced work in October 2006 to connect Griffin Coal to the South West Interconnected System and upgrade the distribution line between Collie and Boddington. This upgrade is scheduled to be completed in 2008, the same year the mine is expected to open and the Bluewaters power station will be operational.

Both coal producers are also examining other areas where they can expand the market for coal with coal carbonising projects whereby coal is transformed into a higher value product known as carbonised coal or char. The commissioning of a 50 000 tonnes per annum Research and Development Char Plant by Wesfarmers continued through the June quarter 2007 with char being produced to specification.

Carpenter Mine Management (CMM), a member of the Griffin Group of companies, is considering two sites for their char plant in the Collie region. The Mungilup Road site located approximately 2 kilometres southwest of the town of Collie and the Ewington site located within one of Griffin's existing mining leases. It is proposed to build (subject to government approvals) a 200 thousand tonnes per year charring operation (fed by 400 thousand tonnes of coal per year from the Ewington mine).

Another project on the horizon is Hydrogen Energy's (a joint venture between the resources giants BP and Rio Tinto) \$2 billion coal-to-hydrogen power generation project at Kwinana alongside BP's refinery and Rio Tinto's HIs melt facility. The project would be an industrial-scale coal-fired power and carbon capture and storage project which would generate 500 megawatts, enough electricity to meet 15 per cent of the southwest Western Australian demand. Using coal from the Collie region and the resulting hydrogen to fuel the power station it is envisaged that it would be operational by 2014.

A possible new development in the Mid West region of the State is Aviva Corporation Ltd's \$1 billion Central West coal project near Eneabba, 270 kilometres north of Perth. Aviva plans to capitalise on the energy needs of the new Mid West iron ore producers and associated industrial and port infrastructure. Aviva Corporation Ltd and ERM Power, a diversified energy solution specialist, announced the commencement of a joint Pre-feasibility Study (PFS), due for completion in October 2007, on a 400 megawatts base-load power station in the Mid West region. Subject to government approvals construction will commence in 2008 with completion in 2011.

### SALT

Western Australia accounts for approximately 95 per cent of the nation's salt production and is the country's dominant exporter. In 2006–07 Western Australian salt sales fell by seven per cent to 10.1 million tonnes, although buoyant prices saw the value almost equal compared to last year to reach \$228 million. Japan accounts for around 32 per cent of the State's exported salt, Taiwan 18 per cent, South Korea 16 per cent, Indonesia 15 per cent, China imports 13 per cent and others six per cent.

Dampier Salt Limited, with its Dampier, Port Hedland and Lake MacLeod operations located in the Pilbara region, accounts for a little over 70 per cent of the total salt produced in Western Australia. Production involves solar evaporation of seawater (Dampier and Port Hedland) and underground brine (Lake MacLeod). The Port Hedland expansion project has been put on hold with priority being given to completing repairs to site from damage caused by Cyclone George. The expansion project is currently undergoing reassessment and redesign to counter escalating costs. However, the Lake MacLeod salt expansion project, to increase tonnage up to 1.9 million tonnes per annum, is well underway and expected to be completed by around November 2007.

Onslow Salt Pty Ltd's operation at Onslow is the next largest operation. The Shark Bay Joint Venture at Useless Loop (which commenced operations in 1968) and the WA Salt Supply's Lake Deborah East (at Koolyanobbing) and Pink Lake (at Esperance) operations make up the smaller producers.

A potential new entrant into Western Australia's solar salt industry is Straits Resources with its \$200 million Yannarie project on the eastern margin of the Exmouth Gulf. Should approvals be granted, construction could commence some time in 2007 with salt production to follow around 2008–09.



Salt is primarily used as a feedstock for the production of chemicals, glass and plastic. In the context of growing demand from Asia, demand for salt is likely to continue to increase. Western Australian salt producers are therefore well placed, due to their proximity to the Asian markets, particularly in the context of rising freight rates for low-value bulk commodities.

## TIN, TANTALUM AND LITHIUM

Tantalum is a rare, grey-blue metal used primarily in the electronics industry in the manufacture of capacitors and therefore found in many every day devices such as mobile phones, lap-top computers and video cameras. Another increasing application for tantalum is as an alloy in the manufacture of turbine blades for power stations and jet engines, where tantalum improves the structural integrity of blades at high temperatures, enabling turbines to operate at higher temperatures, thereby improving fuel efficiency.

There is little public information on the tantalum market and tantalum pricing. However, recent reports confirm that the market continues to be depressed for raw material. Difficulty in establishing a price for tantalum is compounded by the many different types and grades of tantalum.

During 2006–07, Western Australia was reduced to one tantalum producer, Sons of Gwalia Limited (Administrators Appointed) (SOG). Haddington Resources is no longer an active participant in the tantalum industry and in August 2006 sold its tantalum concentrate inventory.

In August 2004, SOG went into voluntary administration and since then the tantalite market has continued to undergo major structural change. There has also been a downturn in the demand for tantalite with resultant depressed raw material price.

SOG announced in February 2006 that it would undertake an operational restructure following recent agreements reached with its two major customers for reduced sales volumes in return for, amongst other things, production and product specification flexibility. The restructure maximised tantalum production at the Wodgina mine which is located 100 kilometres south of Port Hedland. The Greenbushes open cut operation, located 67 kilometres southeast of Bunbury, is operating on reduced tonnages and the underground tantalum operation is on "care and maintenance". Lithium production at Greenbushes continues at capacity.

A news release in June 2007 announced that Denver-based private equity group Resource Capital Funds had won control of Sons of Gwalia.

The Greenbushes and Wodgina mines together contain approximately 75 per cent of the world's defined tantalum reserves and currently supply more than half of the world's demand for tantalum. Both mines have a projected life in excess of 25 years. SOG has two long-standing tantalum customers, Cabot Corporation of the USA and HC Starck, a division of the Bayer Group of Germany. The company has sold all of its production to these two customers since 1991.



Greenbushes also contains the largest hard rock, lithium mineral resource in the world and SOG is the world's largest producer of lithium minerals (spodumene) accounting for around 60 per cent of the world's supply. Lithium minerals are used in the glass and ceramics industries to improve product quality and enhance physical properties.

In another development in 2006, Galaxy Resources purchased from SOG their Cattlin Creek tantalum–lithium prospect (located approximately 550 kilometres southeast of Perth). Galaxy has commenced a full feasibility program which is expected to be completed before the end of 2007.

## MANGANESE AND CHROMITE

Consolidated Minerals' Woodie Woodie mine is the State's sole producing manganese mine. During 2006–07 it reported production of 902 052 tonnes (up two per cent on 2005–06) with an estimated value of around \$135 million. Long-term production levels of one million tonnes per annum are targeted for the future.

The benchmark price for manganese ore into Japan (concluded between BHP Billiton and Nippon Steel) for 2006–07 was announced in December 2005 as US\$3.00 per dry metric tonne unit (dmtu). While off the extraordinary highs of 2005–06, it is 33 per cent more than the average price of US\$2.25 per dry metric tonne unit during the previous ten years and reflects underlying strong world demand for raw steelmaking materials.

The latest price settled for manganese lump ore between BHP Billiton and Nippon Steel is US\$2.70/dmtu commencing from April 2007.

Recent reports on price levels for shipments to China scheduled between August and October 2007 reveal a more than doubling of the average prices received in the first half of 2007.

Manganese is a key component in steel and iron production, which accounts for up to 90 per cent of the metal's current consumption. Essential in iron and steel production, manganese binds, hardens and prevents iron and steel products from being too brittle. It also plays an important role in low-cost stainless steel formulations and aluminium alloys. With high nickel prices some products are replacing nickel with manganese.

Woodie Woodie is recognised worldwide as a supplier of reliable high-grade, low impurity manganese ore. Located 300 kilometres southeast of Port Hedland in the Pilbara region, the open cut mine was first established in 1954 with production peaking around 1970. It continued

operating until 1982 when it closed for a period of some seven years. The mine re-opened again in 1989 and currently exports to around nine different countries. The company has long-term sales agreements in place with China and Europe covering more than 75 per cent of its annual production. Annual sales contracts are also negotiated with Japan, South Korea and Taiwan.

Consolidated Minerals is also the State's sole producer of chromite and in 2006–07 produced 256 936 tonnes for an estimated value of \$52.3 million. The Coobina chromite project is located 80 kilometres southeast of Newman and approximately 590 kilometres south of Port Hedland in the Pilbara region of Western Australia. The mine has an operating capacity of 250 000 tonnes per annum with ore (which represents around 2.5 per cent share of the world market) containing on average 42 per cent chromite.

Globally, chromite production is dominated by South Africa, Kazakhstan, Turkey, India and Pakistan (which together account for 80 per cent of world mine production).

## VANADIUM

Precious Metals Australia (PMA) is in the process of rebuilding the Windimurra vanadium mine which is located 600 kilometres northeast of Perth near the town of Mt Magnet in the Mid West region of Western Australia.

The Windimurra mine originally commenced operations in late 1999 (a JV between PMA and Xtrata), however due to various operational and market difficulties and a period of extended low vanadium price, the mine closed in 2003. PMA has subsequently purchased all remaining assets, information and mining tenements and owns 90 per cent with the Noble Group Limited owning the remaining 10 per cent.

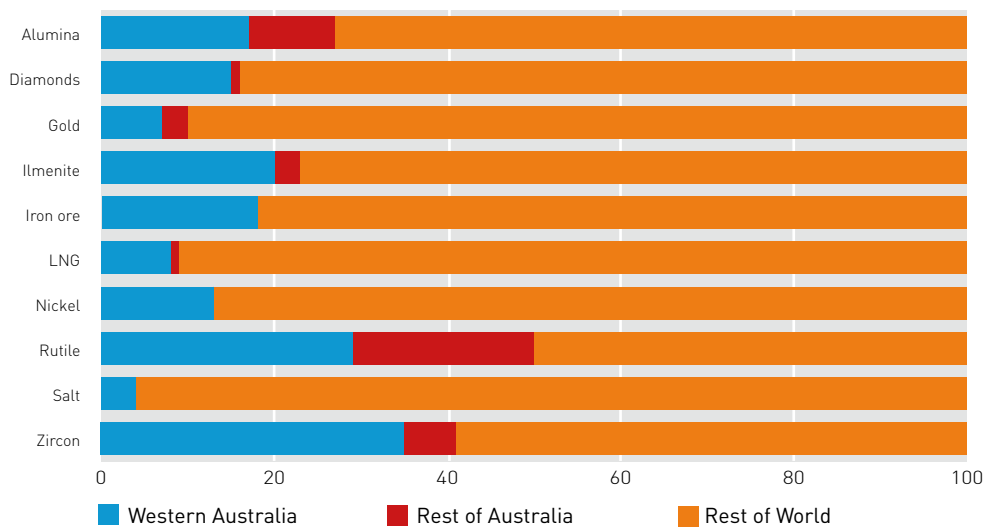


Figure 50 | **Selected WA Commodities Relative to World Production Ending 2006 by Quantity** Source: DoIR, ABARE, USGS

The latest comparable data show that the Western Australian share (by quantity) of the world's output of the following products was: alumina 17%, gold 7%, ilmenite 20%, iron ore 18%, LNG (sea-borne trade) 8%, nickel 13%, rutile 29%, salt 4%, zircon 35% and 15% of diamonds (mainly industrial grade).

The price for ferrovandium in 2003 averaged US\$11.85 per kilogram and it wasn't until the first half of 2005 that prices escalated to a peak of US\$130 per kilogram. This was short-lived however and for the second half of 2005 had settled down to a level somewhere between US\$40 to US\$70 per kilogram. Current levels are averaging around US\$42 per kilogram.

Subject to government approvals PMA has scheduled the reopening of the Windimurra mine for the end of 2007 and once operational will produce products containing approximately 5 000 tonnes of vanadium. The plant will be able to produce either ferrovandium (an alloy of vanadium and iron) or the high purity vanadium pentoxide that was previously produced.

## RARE EARTHS

June 2007 saw the commencement of mining operations at Lynas Corporation Ltd's Mt Weld Rare Earths project located 18 kilometres southeast of the town of Laverton in the Goldfields-Esperance region. The Mt Weld deposit comprises world-class Rare Earths Oxide (REO) and niobium/tantalum (Nb/Ta) deposits. Rare Earths ore will be mined, crushed and blended at Mt Weld, trucked to Leonora, then railed to the port of Esperance for export to Kemaman on the east coast of Malaysia where Lynas plans to establish a processing operation. The Malaysian plant is expected to be complete in the fourth quarter of 2008.

First twelve months production is estimated to be around 120 000 tonnes of ore and first shipment to Malaysia is planned for around May/June 2008. The mine is expected to have at least a 20-year mine-life.

Rare earths are not found as free metals in the Earth's crust, rather within a mixed 'cocktail' of rare earth elements that need to be separated for their individual or combined commercial use. Despite their name, Rare Earths are relatively abundant in the Earth's crust, however they are often of low quality and rarely presented in economic concentration.

Rare earths have unique properties that make them indispensable for many technological applications. A range of unique chemical, catalytic, electrical, magnetic, metallurgical and optical properties enable them to play a major role in the advancement of materials technology.

China currently supplies approximately 95 per cent of the global rare earths market and is the dominant processor and user of refined compounds. This has evolved as processors in the rest of the world transfer production bases to China. In addition, more than 70 per cent of light rare earths are supplied from one mine in China and Mt Weld, (with its very high grade, contains light rare earths and is also high in Europium, a heavy rare earth), is currently the only commercially viable resource of significant size outside China.

Recent changes to Chinese Government regulations will reduce the amount of rare earths being extracted from within China and the supply of high demand elements will require the exploitation of other sources.

The rare earths market is currently growing at 15 per cent per annum and is forecast to continue to do so for the next five years. This, combined with two, five-year supply contracts (worth a combined estimated US\$290 million), strategically places the Mt Weld project in an advantageous position in a time of restricted supply and rising prices.

## MOLYBDENUM-COPPER DEVELOPMENT

Moly Mines Limited is progressing its \$622-million Spinifex Ridge Molybdenum-Copper project towards development. Spinifex Ridge is located approximately 50 kilometres northeast of the town of Marble Bar, itself 140 kilometres east-southeast of the town of Port Hedland. Subject to government approvals and a successful final feasibility study (which is scheduled for completion in the third quarter of 2007), production could commence in mid-2009.

Moly Mines recently announced a five million tonne increase to the design capacity of the proposed processing plant to increase it from 15 to 20 million tonnes per annum.

Molybdenum is a high melting-point alloying metal used in iron, steels and super alloys to enhance hardness, strength, wear and corrosion resistance. High nickel prices have seen an increased usage of molybdenum in stainless steel.

Global consumption of molybdenum has increased 400 per cent since the mid-1990s to approximately 200 000 tonnes per annum. The past three years has seen the price steadily climb to a 25-year high of US\$40 per pound in May 2005 with current levels (average June 2007) of around US\$34 per pound. This is a significant increase on prices of US\$3 to US\$5 per pound paid during the 1990s.

The distribution of molybdenum reserves and production is concentrated in only a few countries. China, the USA, Chile and Canada hold nearly 90 per cent of reserves. The main three producers are the USA (31 per cent), Chile (26 per cent) and China (22 per cent).

World molybdenum supply is constrained by decreasing by-product production from the major South American copper producers, the imposition of export tariffs and quotas in China and lack of new molybdenum mining developments. Spinifex Ridge therefore represents a significant potential new supply source for the global market.

### 3. ROYALTIES

Royalties received from mineral and petroleum producers passed the \$2 billion mark with \$2.09 billion collected during the 2006–07 financial year. This represents the Western Australian share of royalties paid into the State's Consolidated Revenue Fund in 2006–07.

A further \$382.13 million was collected and includes royalties collected on behalf of the Commonwealth from the NWS project (where the State receives approximately 65 per cent of royalties) royalties collected from the Territorial Sea subsisting permit areas and Barrow Island that are shared with the Commonwealth.

In addition, an estimated \$1.56 billion was received by the Commonwealth in 2006–07 from petroleum resource rent tax (PRRT). This tax is applied to operating projects within designated Commonwealth waters off the Western Australian coast.

Focusing on royalties received by Western Australia, increased commodity prices meant the bulk of collections (almost three-quarters) attributed directly to the State came from the iron ore (40 per cent) and petroleum (34 per cent) industry.

This trend in iron ore is likely to continue into the future with prices forecast to increase again in the coming year, the major producers BHP Billiton and Rio Tinto announcing major increases in production as well as a host of projects coming on-stream.



© Pilbara Iron

**TABLE 1 ROYALTY RECEIPTS 2005-06 AND 2006-07**

COMMODITY	2005-06	2006-07	2006-07 Growth	
	Total A\$	Total A\$	A\$	%
ALUMINA	64,090,700	83,444,014	19,353,314	30
DIAMONDS	48,225,088	20,969,209	-27,255,879	(57)
GOLD	81,622,995	104,885,111	23,262,116	28
HEAVY MINERAL SANDS	30,751,011	31,922,003	1,170,992	4
IRON ORE	679,628,477	851,069,611	171,441,134	25
NICKEL, (Includes, cobalt, palladium and platinum)	86,729,918	184,491,190	97,761,272	113
PETROLEUM	678,825,887	714,091,067	35,265,180	5
OTHER	66,711,689	101,802,328	35,090,639	53
<b>TOTAL REVENUE</b>	<b>1,736,585,765</b>	<b>2,092,674,533</b>	<b>356,088,768</b>	<b>21</b>

Note: All Royalty Receipts above are only those paid into the State's Consolidated Revenue Fund during the period. It does not include royalty receipts collected on behalf of the Commonwealth.

A\$ million

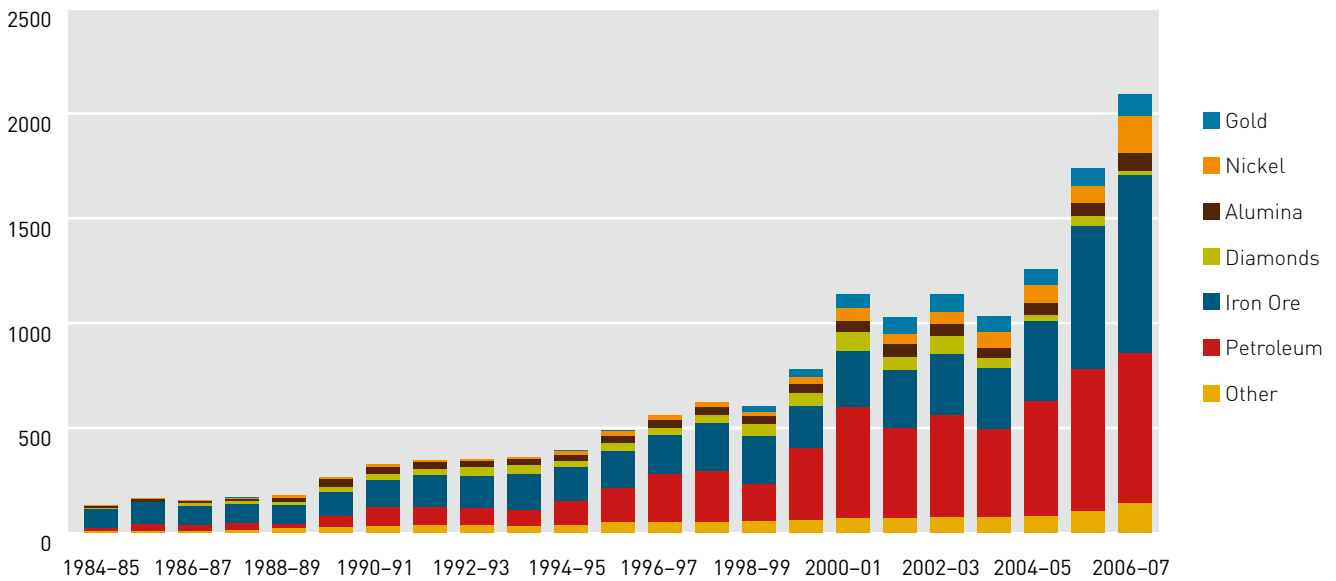


Figure 51 | **Royalty Receipts by Commodity** Source: DoIR

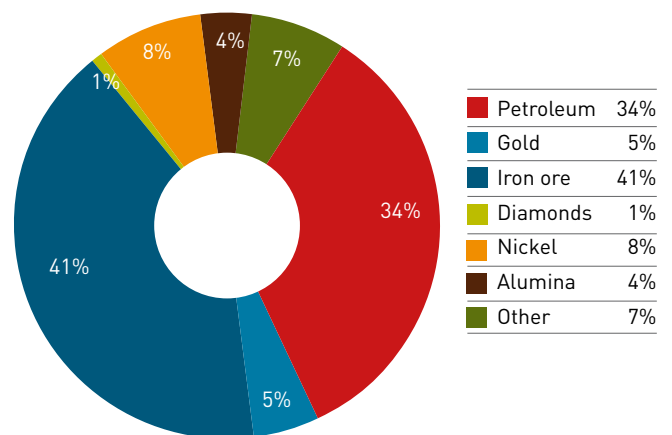


Figure 52 | **Royalty Receipts 2006-07** Source: DoIR

**TABLE 2 QUANTITY AND VALUE OF MINERALS AND PETROLEUM**

Commodity	Unit	2005-06		2006-07	
		Quantity	Value	Quantity	Value
ALUMINA	t	11,466,687	4,111,251,807	11,978,698	4,820,689,834
<b>BASE METALS</b>					
Copper Metal	t	81,202 (r)	559,848,946 (r)	112,280	952,643,762
Lead Metal	t	58,739	86,549,244	56,927	112,187,074
Zinc Metal	t	110,523 (r)	336,650,565 (r)	129,276	618,899,951
<b>TOTAL BASE METALS</b>			983,048,755 (r)		1,683,730,787
CHROMITE	t	105,951	43,033,959	106,063	52,281,337
CLAYS			1,804,890 (r)		1,502,794
COAL	t	6,700,698	296,917,683 (r)	6,017,626	267,004,113
<b>CONSTRUCTION MATERIALS</b>					
Aggregate	t	948,468 (r)	22,553,670 (r)	1,102,665	28,307,131
Gravel	t	131,119 (r)	848,142 (r)	176,724	1,303,316
Rock	t	531,801	6,115,996	389,748	2,084,403
Sand	t	3,659,544 (r)	22,118,522 (r)	4,229,749	22,750,257
<b>TOTAL CONSTRUCTION MATERIALS</b>			50,631,219 (r)		54,445,107
DIAMONDS	ct	29,263,869	n/a	18,222,045	n/a
DIMENSION STONE	t	1,951 (r)	770,591 (r)	1,976	342,863
GEM & SEMI-PRECIOUS STONES	kg	231,957 (r)	212,491 (r)	325,489	253,783
GOLD	kg	166,174 (r)	3,715,051,216 (r)	156,675	4,089,938,122
GYPSUM	t	1,593,862 (r)	26,706,704 (r)	1,494,849	28,402,972
<b>HEAVY MINERAL SANDS</b>					
Garnet	t	278,576	n/a	258,891	n/a
Ilmenite	t	590,243 (r)	65,921,826 (r)	926,027	101,507,854
Leucoxene	t	77,024 (r)	23,947,659 (r)	52,257	19,665,904
Zircon	t	402,424 (r)	357,337,591 (r)	379,893	360,404,346
Other			418,761,089 (r)		373,931,582
<b>TOTAL HEAVY MINERAL SANDS</b>			865,968,165 (r)		931,604,289
<b>IRON ORE</b>					
Domestic	t	4,257,423	226,143,930		
Exported	t	238,370,975 (r)	12,472,950,748 (r)		
<b>TOTAL IRON ORE</b>		242,628,398 (r)	12,699,094,678 (r)	258,277,264	15,750,081,098
<b>LIMESAND-LIMESTONE-DOLOMITE</b>		4,009,487 (r)	42,534,383 (r)	3,791,742	23,235,592
MANGANESE ORE	t	888,432	117,972,661	902,052	134,495,953

**TABLE 2 QUANTITY AND VALUE OF MINERALS AND PETROLEUM**

Commodity	Unit	2005-06		2006-07	
		Quantity	Value	Quantity	Value
<b>NICKEL INDUSTRY</b>					
Cobalt	t	5,017 (r)	183,984,695 (r)	4,859	278,657,202
Nickel	t	183,563 (r)	3,815,110,658 (r)	173,686	7,999,099,188
Palladium and Platinum By-Product	kg	890 (r)	9,742,690 (r)	714	9,693,188
<b>TOTAL NICKEL INDUSTRY</b>			3,974,053,561 (r)		8,287,449,578
<b>PETROLEUM</b>					
Condensate	kl	5,626,187	2,791,727,182	5,860,145	2,972,291,833
Crude Oil	kl	11,157,035 (r)	5,935,124,582 (r)	14,487,266	7,621,480,169
LNG	t	11,679,836	4,625,215,056 (r)	12,211,051	4,237,234,697
LPG - Butane and Propane	t	871,983	654,423,834	898,606	605,084,727
Natural Gas	'000m <sup>3</sup>	7,713,414	703,282,553	8,714,327	919,423,352
<b>TOTAL PETROLEUM</b>			14,709,773,207 (r)		16,355,514,778
<b>SALT</b>	t	10,834,196	229,850,354	10,051,102	228,038,227
<b>SILICA-SILICA SAND</b>		778,115	7,779,625	630,537	6,016,582
<b>SILVER</b>	kg	104,050 (r)	40,301,766 (r)	76,373	51,729,416
<b>TIN-TANTALUM-LITHIUM</b>					
Spodumene	t	193,229	n/a	290,432	n/a
Tantalite	t	871	n/a	674	n/a
Tin Metal	t	610	5,919,842 (r)	419	6,245,046
<b>TOTAL TIN-TANTALUM-LITHIUM</b>			180,395,269 (r)		209,344,553
<b>OTHER (Includes Feldspar, Red Oxide, Spongolite, Talc and Vanadium)</b>			744,327,980 (r)		448,738,496
<b>TOTAL VALUE</b>			<b>42,841,480,963 (r)</b>		<b>53,424,840,276</b>

Note: Quantities used in this table only apply to Minerals and Petroleum covered by the *Mining Act 1978*, the *Petroleum Act 1967*, the *Petroleum (Submerged Lands) Act 1982* and relevant State Agreement Acts.

(r) Revised from previous edition

n/a Breakdown of feldspar, garnet, red oxide, talc, spodumene, tantalite and vanadium not available

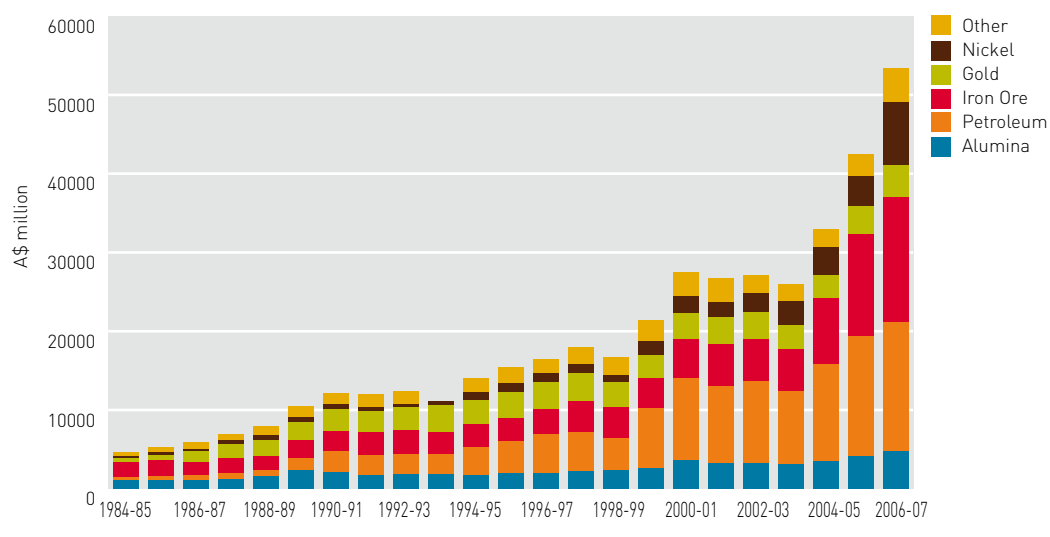
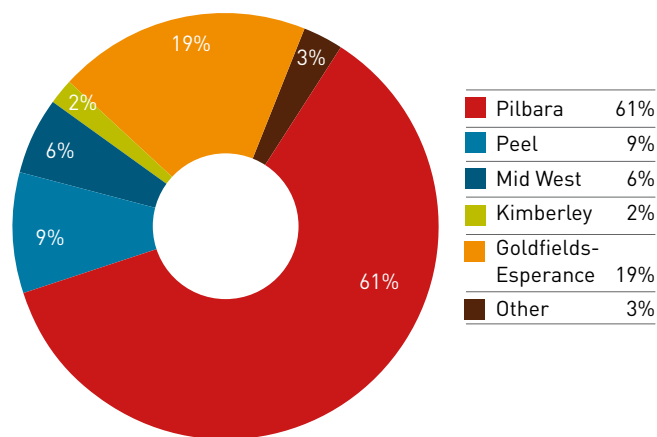


Figure 53 | Value of Mineral and Petroleum by Commodity Source: DoIR

**TABLE 3 VALUE OF MINERALS AND PETROLEUM BY REGION BY LGA 2006–07**

Region	2006–07 Value	Region	2006–07 Value
<b>Pilbara Region</b>		<b>South West Region</b>	
Roebourne	15,398,384,999	Bridgetown–Greenbushes and Capel	395,764,698
East Pilbara	10,603,370,288	Collie	267,201,820
Ashburton	6,423,934,223	Bunbury, Dardanup and Manjimup	59,523,575
Port Hedland	91,982,926	<b>Total</b>	<b>722,490,093</b>
Karratha and Marble Bar	116,083	<b>Wheatbelt Region</b>	
<b>Total</b>	<b>32,517,788,519</b>	Yilgarn	623,665,370
<b>Goldfields–Esperance Region</b>		Dandaragan	194,849,187
Coolgardie	3,309,379,489	Dalwallinu and Kondinin	9,979,188
Leonora	2,758,558,209	Chittering, Corrigin and Moora	1,332,034
Kalgoorlie–Boulder	1,873,787,457	Gingin and Wyalkatchem	1,233,431
Laverton	1,729,337,544	Mukinbudin, Northam and Nungarin	559,989
Dundas	497,498,145	Lake Grace	231,657
Menzies	17,587,280	<b>Total</b>	<b>831,850,856</b>
Ravensthorpe	2,133,521	<b>Gascoyne Region</b>	
Esperance	563,384	Carnarvon	49,073,567
<b>Total</b>	<b>10,188,845,028</b>	Exmouth, Shark Bay and Upper Gascoyne	23,746,318
<b>Peel Region</b>		<b>Total</b>	<b>72,819,885</b>
Waroona	3,456,856,445	<b>Perth Metropolitan Region</b>	
Boddington	1,363,833,389	Kalamunda, Swan and Wanneroo	17,499,229
<b>Total</b>	<b>4,820,689,834</b>	Cockburn, Kwinana and Rockingham	12,843,818
<b>Mid West Region</b>		<b>Total</b>	<b>30,343,047</b>
Wiluna and Three Springs	801,101,169	<b>Great Southern Region</b>	
Yalgoo	864,467,148	Albany, Kent and Plantagenet	3,462,214
Irwin	449,901,245		
Carnamah and Coorow	430,665,280		
Morawa, Mullewa	313,191,606		
Meekatharra	254,802,275		
Northhampton, Perenjori	106,308,444		
Cue	25,187,375		
<b>Total</b>	<b>3,245,624,542</b>		
<b>Kimberley Region</b>			
Halls Creek	439,075,787		
Wyndham–East Kimberley	384,031,000		
Derby–West Kimberley	163,447,374		
Broome	4,372,097		
<b>Total</b>	<b>990,926,258</b>		


**Figure 54 | Value of Minerals and Petroleum by Region 2006–07 Total \$53.4 billion** Source: DoIR



**TABLE 4 VALUE OF MINERALS AND PETROLEUM BY REGION BY COMMODITY 2006-07**

Region	2006-07 Value	Region	2006-07 Value
<b>Pilbara Region</b>		<b>Kimberley Region</b>	
Iron Ore	14,986,769,312	Nickel, Cobalt and Diamonds	838,601,048
Crude Oil and Condensate	10,171,369,121	Iron Ore, Copper and Gold	145,459,655
Liquefied Natural Gas	4,237,234,697	Other	6,865,555
Natural Gas	890,069,560	<b>Total</b>	<b>990,926,258</b>
Copper	727,931,835	<b>South West Region</b>	
LPG Butane and Propane	605,084,727	Heavy Mineral Sands	275,630,248
Gold	518,421,356	Coal	267,004,113
Salt	174,930,884	Tin, Tantalum and Spodumene	179,649,298
Manganese	134,495,953	Other	275,836,682
Other	71,481,073	<b>Total</b>	<b>722,490,093</b>
<b>Total</b>	<b>32,517,788,519</b>	<b>Wheatbelt Region</b>	
<b>Goldfields-Esperance Region</b>		Iron Ore and Gold	616,908,168
Nickel	7,242,184,295	Gypsum and Heavy Mineral Sands	196,350,196
Gold	2,636,719,039	Nickel and Salt	14,722,947
Cobalt	244,299,881	Other	3,869,545
Copper	26,473,705	<b>Total</b>	<b>831,850,856</b>
Silver	13,720,428	<b>Gascoyne Region</b>	
Construction Materials	3,992,748	Salt and Gems	46,730,899
Other	21,454,931	Gypsum and Limesand-Limestone	26,076,092
<b>Total</b>	<b>10,188,845,028</b>	Other	12,894
<b>Peel Region</b>		<b>Total</b>	<b>72,819,885</b>
Alumina	4,820,689,834	<b>Perth Metropolitan Region</b>	
<b>Mid West Region</b>		Construction Materials, Silica Sand,	32,717,615
Gold	795,160,641	<b>Great Southern Region</b>	
Zinc	618,899,951	Spongolite and Construction Materials	1,941,577
Nickel, Cobalt and Iron Ore	540,391,505		
Heavy Mineral Sands	461,980,483		
Crude Oil	419,786,875		
Copper	166,287,258		
Lead	112,187,074		
Chromite	52,281,337		
Silver	33,969,902		
Natural Gas	29,353,792		
Other	14,471,792		
<b>Total</b>	<b>3,244,770,611</b>		

**TABLE 5 QUANTITY AND VALUE OF SELECTED MAJOR COMMODITIES**

	Unit	1997-98		1998-99		1999-00		2000-01	
		Quantity	Value \$M	Quantity	Value \$M	Quantity	Value \$M	Quantity	Value \$M
<b>ALUMINA</b>	Mt	8.51	2,260.54	8.86	2,367.03	9.35	2,657.89	10.48	3,600.67
<b>BASE METALS</b>									
Copper Metal	kt	29.43	61.12	24.44	43.71	30.73	64.62	42.62	111.12
Lead Metal	kt	27.00	10.45	51.55	17.25	64.47	20.24	82.33	37.31
Zinc Metal	kt	124.00	117.11	194.90	170.73	232.59	251.01	236.01	280.24
<b>TOTAL BASE METALS</b>			188.68		231.69		335.87		428.67
<b>COAL</b>	Mt	5.71	257.28	5.80	256.74	6.50	271.53	6.10	252.28
<b>COBALT</b>	kt	1.50	81.78	1.09	55.27	2.07	86.26	4.19	174.38
<b>DIAMONDS ***</b>	M ct	42.48	537.87	51.23	610.44	50.98	703.67	25.42	614.45
<b>GOLD</b>	t	239.46	3,468.95	219.26	3,219.52	204.96	2,951.26	201.21	3,245.06
<b>HEAVY MINERAL SANDS</b>									
Ilmenite	Mt	1.31	149.14	1.32	158.59	1.16	151.66	1.10	168.75
Rutile	kt	104.13	78.58	119.71	90.97	98.49	72.78	127.21	110.04
Upgraded Ilmenite (Synthetic Rutile)	kt	688.00	355.79	475.54	275.23	552.51	324.65	643.27	409.19
Zircon	kt	321.38	169.13	284.53	136.07	348.11	153.27	343.08	198.84
Other HMS			24.63		19.44		28.85		18.08
<b>TOTAL HEAVY MINERAL SANDS</b>			777.27		680.30		731.20		904.90
<b>IRON ORE</b>	Mt	149.74	3,930.77	141.03	3,898.53	151.16	3,722.12	161.77	4,912.70
<b>MANGANESE ORE</b>	kt	86.30	9.39	27.40	3.42	212.38	25.68	401.36	58.50
<b>NICKEL</b>	kt	135.19	1,146.64	125.77	876.62	143.93	1,806.29	167.45	2,238.74
<b>PETROLEUM</b>									
Condensate	Gl	6.76	1,065.84	5.55	743.91	6.35	1,583.94	5.81	1,984.53
Crude oil	Gl	9.85	1,567.16	9.16	1,189.64	12.05	3,144.77	13.96	4,792.05
LNG *	Btu 10 <sup>12</sup> & t	379.54	1,591.94	391.90	1,434.42	393.61	1,971.06	429.54	2,695.53
LPG - Butane **	kt	376.09	90.47	388.69	90.62	443.58	190.90	428.90	221.97
LPG - Propane	kt	263.26	61.26	259.21	57.63	334.57	145.94	333.47	187.54
Natural Gas	Gm <sup>3</sup>	6.88	557.47	6.44	549.83	6.55	578.76	7.63	630.36
<b>TOTAL PETROLEUM</b>			4,934.14		4,066.65		7,615.37		10,511.98
<b>SALT</b>	Mt	8.19	188.70	8.57	199.64	8.81	208.58	8.30	233.08
<b>OTHER</b>			153.07		189.73		229.26		371.67
<b>TOTAL</b>			<b>17,935.08</b>		<b>16,655.58</b>		<b>21,344.98</b>		<b>27,547.08</b>

\* Expressed in million tonnes from 2004-05 onwards

\*\* LPG Butane and Propane combined from 2004-05 onwards

\*\*\* Diamond values are not available from 2005-06 onwards and quantities are published production carats

2001-02		2002-03		2003-04		2004-05		2005-06		2006-07	
Quantity	Value \$M	Quantity	Value \$M	Quantity	Value \$M	Quantity	Value \$M	Quantity	Value \$M	Quantity	Value \$M
10.86	3,584.38	11.13	3,204.65	11.17	3,085.11	11.16	3,461.63	11.47	4,111.25	11.98	4,820.69
53.50	122.57	59.45	138.78	53.29	155.82	61.93	243.73	81.20	559.85	112.28	952.64
75.08	36.72	70.02	31.85	29.45	10.57	2.32	0.31	58.74	86.55	56.93	112.19
223.67	173.82	206.45	173.19	108.04	79.55	48.40	42.42	110.52	336.65	129.28	618.90
	333.11		343.82		245.95		286.46		983.05		1,683.73
6.16	258.13	6.32	272.89	5.98	274.28	6.28	271.72	6.71	297.37	6.02	267.00
4.43	127.36	4.92	124.18	4.55	213.14	4.50	202.38	5.02	183.98	4.86	278.66
25.69	489.34	38.89	773.32	32.50	519.72	22.80	n/a	29.26	n/a	18.22	n/a
185.00	3,279.50	187.47	3,445.34	177.01	3,109.56	167.35	3,016.38	166.17	3,715.05	156.68	4,089.94
0.80	128.75	0.96	136.51	0.76	91.03	0.71	79.55	590.24	65.92	926.03	101.51
122.61	106.74	113.57	82.53	138.77	84.57	101.71	63.02	n/a	n/a	n/a	n/a
585.91	380.21	597.27	353.10	592.18	307.00	652.94	336.37	n/a	n/a	n/a	n/a
317.77	218.84	411.15	255.81	433.14	251.97	420.04	298.37	402.42	357.34	379.89	360.40
	19.78		16.86		20.53		23.58		442.71		469.69
	854.32		844.81		755.10		800.89		865.97		931.60
164.63	5,207.61	188.52	5,205.27	202.04	5,331.53	233.15	8,302.34	242.63	12,699.09	258.28	15,750.08
474.27	68.62	619.65	75.38	584.97	81.78	606.94	116.32	888.43	117.97	902.05	134.50
179.46	2,002.07	191.89	2,482.47	182.21	3,031.04	180.42	3,503.20	183.56	3,815.11	173.69	7,999.10
6.33	1,680.03	6.93	2,046.37	6.18	1,747.51	5.63	2,203.11	5.63	2,791.73	5.86	2,972.29
15.09	4,198.78	14.00	4,258.12	13.22	3,773.64	12.80	5,146.61	11.516	5,935.12	14.49	7,621.48
386.08	2,970.61	403.83	3,130.83	404.94	2,775.88	11.04	3,953.10	11.68	4,625.22	12.21	4,237.23
482.20	193.71	460.47	221.47	383.92	154.13	77.17	421.74	871.98	654.42	898.61	605.09
374.32	167.87	346.60	172.39	311.35	128.02						
7.53	643.28	8.12	661.92	8.06	694.07	7.64	678.72	7.71	703.28	8.71	919.42
	9,854.28		10,491.10		9,273.25		12,403.29		14,709.77		16,355.51
8.60	227.95	9.61	227.95	9.88	179.85	11.58	221.25	10.83	229.85	10.01	228.04
	409.47		366.48		316.87		820.06		1,113.02		879.05
<b>26,696.14</b>		<b>27,857.66</b>		<b>26,417.17</b>		<b>33,405.91</b>		<b>42,841.48</b>		<b>53,417.90</b>	

**TABLE 6 PRINCIPAL MINERAL AND PETROLEUM PRODUCERS EFFECTIVE 1 SEPTEMBER 2007**

## BASE METALS

### COPPER-LEAD-ZINC

#### Birla Nifty Pty Ltd

Level 3, 256 Adelaide Terrace  
Perth WA 6000  
(08) 9366 8800  
Nifty

[www.adityabirla.com/our\\_companies/international\\_companies/birla\\_nifty.htm](http://www.adityabirla.com/our_companies/international_companies/birla_nifty.htm)

#### BHP Billiton (Nickel West)

191 Great Eastern Highway  
Belmont WA 6104  
(08) 9479 0500  
Kambalda  
[www.bhpbilliton.com](http://www.bhpbilliton.com)

#### Fox Resources Ltd

Suite 1 and 2  
614 Newcastle Street  
Leederville WA 6007  
(08) 9318 5600  
Whundo  
[www.foxresources.com.au](http://www.foxresources.com.au)

#### Newcrest Mining Ltd

Level 2, 20 Terrace Road  
East Perth WA 6004  
(08) 9270 7070  
Telfer  
[www.newcrest.com.au](http://www.newcrest.com.au)

#### Magellan Metals Pty Ltd

96 Welshpool Road  
Welshpool WA 6106  
(08) 9267 7000  
Magellan  
[www.iverynia.com](http://www.iverynia.com)

#### Oxiana Limited

Level 9, 31 Queen Street  
Melbourne Vic 3000  
(03) 8623 2200  
Golden Grove  
[www.oxiana.com.au](http://www.oxiana.com.au)

#### Straits Resources Limited

Level 1, 35 Ventnor Avenue  
West Perth WA 6005  
(08) 9480 0500  
Mons Cupri  
[www.straits.com.au](http://www.straits.com.au)

## BAUXITE-ALUMINA

### ALUMINA

#### Alcoa World Alumina Australia

181-205 Davy Street  
Booragoon WA 6154  
(08) 9316 5111  
Del Park, Willowdale, Huntly  
[www.alcoa.com.au](http://www.alcoa.com.au)

#### Worsley Alumina Pty Ltd

PO Box 344  
Collie WA 6225  
(08) 9734 8311  
Boddington  
[www.wapl.com.au](http://www.wapl.com.au)

## CHROMITE

### CHROMITE ORE

#### Pilbara Chromite Pty Ltd

28 Ventnor Ave  
West Perth WA 6005  
(08) 9321 3633  
Coobina  
[www.consminerals.com.au](http://www.consminerals.com.au)

## CLAY

### ATTAPULGITE

#### Hudson Resources Ltd

2 Kemp Street, Narngulu  
Geraldton WA 6530  
(08) 9923 3604  
Lake Narramyne  
[www.hudsonresources.com](http://www.hudsonresources.com)

### CLAY SHALE

#### The Griffin Coal Mining Company Pty Limited

28 The Esplanade  
Perth WA 6000  
(08) 9261 2800  
Collie  
[www.griffincoal.com.au](http://www.griffincoal.com.au)

### FIRE CLAY

#### Midland Brick Company Pty Ltd

102 Great Northern Highway  
Middle Swan WA 6056  
(08) 9273 5522  
Bullsbrook North  
[www.midlandbrick.com.au](http://www.midlandbrick.com.au)

### KAOLIN

#### Sons of Gwalia Ltd

Level 3, 30 The Esplanade  
Perth WA 6000  
(08) 9263 5555  
Greenbushes  
[www.sog.com.au](http://www.sog.com.au)

### SAPONITE

#### Watheroo Minerals Pty Ltd

PO Box 353  
Dunsborough WA 6281  
(08) 9756 6121  
Watheroo Clays  
[www.bentoniteproductswa.com.au](http://www.bentoniteproductswa.com.au)

## COAL

#### The Griffin Coal Mining Company Pty Limited

28 The Esplanade  
Perth WA 6000  
(08) 9261 2800  
Collie  
[www.griffincoal.com.au](http://www.griffincoal.com.au)

#### Wesfarmers Premier Coal Ltd

Premier Road  
Collie WA 6225  
(08) 9780 2222  
Collie  
[www.wesfarmers.com.au](http://www.wesfarmers.com.au)

## CONSTRUCTION MATERIALS

### AGGREGATE

#### The Readymix Group (WA)

Technology Park  
18-20 Brodie Hall Drive  
Bentley WA 6102  
(08) 9212 2000  
Boodarie, Burrup-Dampier  
[www.readymix.com.au](http://www.readymix.com.au)

### GRAVEL

#### Boral Resources (WA) Ltd

63-69 Abernethy Road  
Belmont WA 6104  
(08) 9333 3400  
Grosmont  
[www.boral.com.au](http://www.boral.com.au)

#### WA Limestone Co.

41 Spearwood Avenue  
Bibra Lake WA 6163  
(08) 9434 2299  
Pickering Brook

### SAND

#### Boral Resources (WA) Ltd

63-69 Abernethy Road  
Belmont WA 6104  
(08) 9333 3400  
Grosmont  
[www.boral.com.au](http://www.boral.com.au)

#### Rocla Quarry Products

130 Fauntleroy Avenue  
Redcliffe WA 6104  
(08) 9475 2555  
Gnangarra  
[www.rocla.com.au](http://www.rocla.com.au)

**TABLE 6 PRINCIPAL MINERAL AND PETROLEUM PRODUCERS EFFECTIVE 1 SEPTEMBER 2007**

**The Readymix Group (WA)**

Technology Park  
18-20 Brodie Hall Drive  
Bentley WA 6102  
(08) 9212 2000  
Various sites  
[www.readymix.com.au](http://www.readymix.com.au)

**Tuma Holdings Pty Ltd**

T/as Action Sand Supplies  
42 Noel Road  
Gooseberry Hill WA 6076  
(08) 9275 1100  
Mobile: 0408 923 801  
The Lakes, Mundaring

**DIAMONDS**

**Argyle Diamonds Australia**

2 Kings Park Road  
West Perth WA 6005  
(08) 9482 1166  
Argyle  
[www.argylediamonds.com.au](http://www.argylediamonds.com.au)

**Kimberley Diamond Company**

12 Walker Avenue  
West Perth WA 6005  
(08) 9321 5887  
Ellendale  
[www.kimberleydiamondco.com.au](http://www.kimberleydiamondco.com.au)

**DIMENSION STONE**

**GRANITE**

**Fraser Range Granite NL**

Eyre Highway  
Norseman WA 6443  
(08) 9039 3442  
Fraser Range Granite

**FELDSPAR**

**Unimin Australia Ltd**

26-28 Tomlinson Road  
Welshpool WA 6106  
(08) 9362 1655  
Pippingarra, Mukinbudin  
[www.unimin.com.au](http://www.unimin.com.au)

**GOLD**

**Agnew Gold Mining Co Pty Ltd**

PMB 10  
Leinster WA 6437  
(08) 9088 3822  
Agnew  
[www.goldfields.co.za](http://www.goldfields.co.za)

**AngloGold Australia Ltd**

Level 13, St Martin's Tower  
44 St Georges Terrace  
Perth WA 6000  
(08) 9425 4600  
Sunrise Dam  
[www.anglogold.com](http://www.anglogold.com)

**Barrick Gold of Australia Limited**

Level 10, 2 Mill Street  
Perth WA 6000  
(08) 9212 5777  
Darlot, Lawlers, Plutonic, Granny Smith,  
Kanowna Belle, Golden Feather,  
Kundana, Paddington  
[www.barrick.com](http://www.barrick.com)

**Croesus Mining NL**

39 Porter Street  
Kalgoorlie WA 6430  
(08) 9091 2222  
Central Norseman  
[www.croesus.com.au](http://www.croesus.com.au)

**Equigold NL**

1st Floor, 7 Sleaf Road  
Applecross WA 6153  
(08) 9316 3661  
Kirkalocka  
[www.equigold.com.au](http://www.equigold.com.au)

**Harmony Gold (Australia) Pty Ltd**

Level 1, 10 Ord Street  
West Perth WA 6005  
(08) 9211 3100  
Hill 50-Mt Magnet,  
South Kal Mines-New Celebration,  
[www.harmony.co.za](http://www.harmony.co.za)

**Kalgoorlie Consolidated**

**Gold Mines Pty Ltd**  
Private Bag 27  
Kalgoorlie WA 6433  
(08) 9022 1100  
Golden Mile Fimiston Super Pit  
[www.superpit.com.au](http://www.superpit.com.au)

**LionOre Australia Pty Ltd**

PO Box 205  
Leinster WA 6437  
(08) 9088 3400  
Thunderbox  
[www.lionore.com](http://www.lionore.com)

**Monarch Gold Mining Company Limited**

Level 1, 23 Ventnor Avenue  
West Perth WA 6005  
(08) 9481 6422  
Davyhurst,  
[www.mrl.net.au](http://www.mrl.net.au)

**Newcrest Mining Ltd**

Level 2, 20 Terrace Road  
East Perth WA 6004  
(08) 9270 7070  
Telfer  
[www.newcrest.com.au](http://www.newcrest.com.au)

**Newmont Australia**

PO Box 1652  
Subiaco WA 6904  
(08) 9983 7000 [site]  
Jundee-Nimary  
[www.newmont.com](http://www.newmont.com)

**Nustar Mining Corporation Limited**

Level 2, 34 Colin Street  
West Perth WA 6005  
(08) 9346 0000  
Paulsens  
[www.nustarmining.com.au](http://www.nustarmining.com.au)

**St Barbara Mines Ltd**

1205 Hay Street  
West Perth WA 6005  
(08) 9476 5555  
Marvel Loch-Southern Cross  
[www.stbarbara.com.au](http://www.stbarbara.com.au)

**St Ives Gold Mining Co Pty Ltd**

POB 359  
Kambalda WA 6442  
(08) 9088 1111  
Kambalda-St Ives  
[www.goldfields.co.za](http://www.goldfields.co.za)

**Troy Resources NL**

44 Ord Street  
West Perth WA 6005  
(08) 9481 1277  
Sandstone  
[www.troy.com.au](http://www.troy.com.au)

**Yilgarn Mining Ltd**

Suite 3, 9 Bowman Street  
South Perth WA 6151  
(08) 9474 3911  
Rose Dam  
[www.yilgarnmining.com.au](http://www.yilgarnmining.com.au)

**GYPSUM**

**Cockburn Cement Ltd**

Lot 242 Russell Road East  
East Munster WA 6166  
(08) 9411 1000  
Lake Hillman

**TABLE 6 PRINCIPAL MINERAL AND PETROLEUM PRODUCERS EFFECTIVE 1 SEPTEMBER 2007**

**CSR Limited**

21 Sheffield Road  
Welshpool WA 6106  
(08) 9365 1666  
Jurien Bay North

**Dampier Salt Pty Ltd**

37 Belmont Avenue  
Belmont WA 6104  
(08) 9270 9270  
Lake MacLeod  
[www.dampiersalt.com.au](http://www.dampiersalt.com.au)

**Gypsum Industries**

PO Box 952  
Canning Bridge WA 6153  
(08) 9364 4951  
Lake Cowcowing  
[www.aglime.com.au](http://www.aglime.com.au)

**Lake Hillman Mining Pty Ltd**

PO Box 1  
Kalannie WA 6468  
(08) 9666 2045  
Lake Hillman

**HEAVY MINERAL SANDS**

**GARNET SAND**

**GMA Garnet Pty Ltd**

PO Box 188  
Geraldton WA 6531  
(08) 9923 3644  
Port Gregory  
[www.garnetsales.com](http://www.garnetsales.com)

**ILMENITE, LEUCOXENE,  
RUTILE AND ZIRCON**

**Cable Sands (WA) Pty Ltd**

PO Box 133  
Bunbury WA 6231  
(08) 9721 0200  
Jangardup, Sandalwood,  
Ludlow, Tutunup  
[www.cablesands.com.au](http://www.cablesands.com.au)

**Doral Mineral Sands**

Lot 7 Harris Road  
Picton WA 6229  
(08) 9725 4899  
[www.doral.com.au](http://www.doral.com.au)

**Iluka Resources Ltd**

Level 23, 140 St Georges Terrace  
Perth WA 6000  
(08) 9360 4700  
Capel, Eneabba, Yoganup  
[www.iluka.com](http://www.iluka.com)

**TiWest Pty Ltd**

1 Brodie Hall Drive  
Bentley WA 6102  
(08) 9365 1333  
Cooljarloo  
[www.tiwest.com.au](http://www.tiwest.com.au)

**IRON ORE**

**BHP Billiton Iron Ore (Goldsworthy) Ltd**

225 St Georges Terrace  
Perth WA 6000  
(08) 9320 4444  
Mining Area C, Nimingarra–Yarrie  
[www.bhpbilliton.com](http://www.bhpbilliton.com)

**BHP Billiton Iron Ore Ltd**

225 St Georges Terrace  
Perth WA 6000  
(08) 9320 4444  
Jimblebar, Newman, Yandicoogina  
[www.bhpbilliton.com](http://www.bhpbilliton.com)

**Channar Mining Pty Ltd**

152 St Georges Terrace  
Perth WA 6000  
(08) 9327 2327  
Channar

**Hamersley Iron Pty Ltd**

152 St Georges Terrace  
Perth WA 6000  
(08) 9327 2327  
Brockman, Marandoo, Paraburdoo,  
Tom Price, Yandicoogina  
[www.hamersleyiron.com](http://www.hamersleyiron.com)

**Midwest Corporation Limited**

Suite 2, 32 Kings Park Road  
West Perth WA 6005  
(08) 9226 2033  
Koolanooka  
[www.midwest.com.au](http://www.midwest.com.au)

**Mt Gibson Iron Limited**

1st Floor, 7 Havelock Street  
West Perth WA 6005  
(08) 9426 7500  
Tallering Peak  
[www.mtgibsoniron.com.au](http://www.mtgibsoniron.com.au)

**Murchison Metals Ltd**

Level 2, 18 Richardson Street  
West Perth WA 6005  
(08) 9483 0500  
Jack Hills  
[www.mml.net.au](http://www.mml.net.au)

**Portman Iron Ore Ltd**

Level 11, 1 William Street  
Perth WA 6000  
(08) 9426 3333  
Cockatoo Island, Koolyanobbing  
[www.portman.com.au](http://www.portman.com.au)

**Robe River Iron Associates**

Level 27 Central Park  
152-158 St Georges Terrace  
Perth WA 6000  
(08) 9327 2800  
Pannawonica, West Angelas  
[www.roberiver.com.au](http://www.roberiver.com.au)

**LIMESAND–LIMESTONE**

**Cockburn Cement Ltd**

Lot 242 Russell Road East  
East Munster WA 6163  
(08) 9411 1000  
Cockburn, Dongara, Wanneroo  
[www.cockburncement.com.au](http://www.cockburncement.com.au)

**Limestone Resources Australia Pty Ltd**

Unit 1, 7 Guthrie Street  
Osborne Park WA 6017  
(08) 9445 3433  
Wanneroo, Moore River, Carabooda  
[www.limestone-resources.com.au](http://www.limestone-resources.com.au)

**Loongana Lime Pty Ltd**

PO Box 808  
Kalgoorlie WA 6430  
(08) 9021 8055  
Loongana

**WA Limestone Co.**

41 Spearwood Avenue  
Bibra Lake WA 6163  
(08) 9434 2299  
Postans

**Gypsum Industries of Australia**

PO Box 952  
Canning Bridge WA 6153  
(08) 9364 4951  
Dongara–Denison, Cervantes,  
Lancelin, Jurien

**MANGANESE**

**Pilbara Manganese Pty Ltd**

28 Ventor Avenue  
West Perth WA 6005  
(08) 9321 3633  
Woodie Woodie  
[www.consminerals.com.au](http://www.consminerals.com.au)

**TABLE 6 PRINCIPAL MINERAL AND PETROLEUM PRODUCERS EFFECTIVE 1 SEPTEMBER 2007**

## NICKEL

### Australian Mines Limited

Level 1, 681 Murray Street  
West Perth WA 6005  
(08) 9481 5811

Blair

[www.australianmines.com.au](http://www.australianmines.com.au)

### BHP Billiton (Nickel West)

191 Great Eastern Highway  
Belmont WA 6104  
(08) 9479 0500

Kambalda, Leinster, Mt Keith

[www.bhpbilliton.com](http://www.bhpbilliton.com)

### Consolidated Minerals Limited

28 Ventnor Avenue  
West Perth WA 6005

(08) 9321 3633

Beta Hunt

[www.consminerals.com.au](http://www.consminerals.com.au)

### Fox Resources Ltd

Suite 1 and 2, 614 Newcastle Street  
Leederville WA 6007

(08) 9318 5600

Radio Hill

[www.foxresources.com.au](http://www.foxresources.com.au)

### Glenmurrin Pty Ltd

30 The Esplanade  
Perth WA 6000

(08) 9226 1099

Murrin Murrin

[www.glencore.com](http://www.glencore.com)

### Minara Resources Ltd

Level 4, 30 The Esplanade  
Perth WA 6000

(08) 9212 8400

Murrin Murrin

[www.minara.com.au](http://www.minara.com.au)

### Independence Group NL

PO Box 893

South Perth WA 6951

(08) 9367 2755

Long Nickel

[www.independencegroup.com.au](http://www.independencegroup.com.au)

### LionOre (Australia) Pty Ltd

Level 3, 88 Colin Street

West Perth WA 6005

(08) 9426 0100

Black Swan, Emily Ann, Maggie Hays

[www.lionore.com](http://www.lionore.com)

### Mincor Resources NL

Level 1, 1 Havelock Street  
West Perth WA 6005

(08) 9321 7125

Miitel, Wannaway, Redross, Mariners

[www.mincor.com.au](http://www.mincor.com.au)

### OMG Cawse Pty Ltd

Cawse Nickel Operations  
Locked Bag 32

Kalgoorlie WA 6433

(08) 9024 8800

Cawse

[www.omgi.com](http://www.omgi.com)

### Sally Malay Mining Ltd

Level 22 Allendale Square  
77 St Georges Terrace

Perth WA 6000

(08) 9225 0999

Sally Malay, Lanfranchi Tramways

[www.sallymalay.com](http://www.sallymalay.com)

### Sir Samuel Mines NL

3rd Floor, 24 Outram Street  
West Perth WA 6005

(08) 9213 1588

Cosmos

[www.jubileemines.com.au](http://www.jubileemines.com.au)

### Tectonic Resources NL

Suite 4, 100 Hay Street  
Subiaco WA 6008

(08) 9388 3872

RAV8

[www.tectonicres.com.au](http://www.tectonicres.com.au)

### View Resources Ltd

Level 12, London House  
216 St Georges Terrace

Perth WA 6000

(08) 9226 4611

Carnilya Hill

[www.viewresources.com.au](http://www.viewresources.com.au)

### Western Areas NL

Level 1, 11 Ventnor Avenue  
West Perth WA 6005

(08) 9486 7855

Flying Fox

[www.westernareas.com.au](http://www.westernareas.com.au)

## PALLADIUM

### BHP Billiton (Nickel West)

191 Great Eastern Highway  
Belmont WA 6104

(08) 9479 0500

Kambalda

[www.bhpbilliton.com](http://www.bhpbilliton.com)

## PETROLEUM

### Apache Energy Ltd

Level 3, 256 St Georges Terrace  
Perth WA 6000

(08) 9422 7222

Agincourt, Albert, Artreus, Bambra, Campbell, Double Island, Endymion, Gipsy, Gudrun, Harriet, Hoover, Linda, Little Sandy, Mohave, Monet, North Alkimos, North Pedirka, Pedirka, Rose, Simpson, Sinbad, South Plato, Stag, Tanami, Victoria, Wonnich

[www.apachecorp.com](http://www.apachecorp.com)

### ARC Energy Ltd

Level 4, 679 Murray Street  
West Perth WA 6005

(08) 9486 7333

Dongara, Evandra, Hovea-Eremita, Xyris

[www.arcenergy.com.au](http://www.arcenergy.com.au)

### BHP Billiton Petroleum (North West Shelf) Pty Ltd

Level 42, Central Park  
152-158 St Georges Terrace  
Perth WA 6000

(08) 9278 4888

Chinook-Scindian, Griffin

[www.bhpbilliton.com](http://www.bhpbilliton.com)

### ChevronTexaco Australia Pty Ltd

Level 24, QV1 Building  
250 St Georges Terrace

Perth WA 6000

(08) 9216 4000

Barrow Island, Cowle, Crest, Roller-Skate, Saladin, Yammaderry

[www.chevron.com](http://www.chevron.com)

### ENI Australia Limited

Level 3, 40 Kings Park Road  
West Perth WA 6005

(08) 9320 1111

Woollybutt

### Kimberley Oil NL

Suite 12B, 573 Canning Highway  
Alfred Cove WA 6154

(08) 9330 8876

Blina

[www.kimberleyoil.com.au](http://www.kimberleyoil.com.au)

**TABLE 6 PRINCIPAL MINERAL AND PETROLEUM PRODUCERS EFFECTIVE 1 SEPTEMBER 2007**

**Origin Energy Resources Ltd**

34 Collins Street  
West Perth WA 6005  
(09) 9324 6111  
Beharra Springs, Jingemina, Tarantula  
[www.originenergy.com.au](http://www.originenergy.com.au)

**Santos Limited**

Level 29 Santos House  
91 King William Street  
Adelaide SA 5000  
(08) 8218 5111  
Mutineer-Exeter  
[www.santos.com.au](http://www.santos.com.au)

**Vermillion Energy**

Level 7 BNZ House  
30 The Esplanade  
Perth WA 6000  
(08) 480 0300  
Wandoo  
[www.vermillionenergy.com.au](http://www.vermillionenergy.com.au)

**Woodside Energy Ltd**

240 St Georges Terrace  
Perth WA 6000  
(08) 9348 4000  
Athena, Cossack, Echo-Yodel,  
Goodwyn, Hermes, Lambert,  
Laminaria, Legendre,  
North Rankin, Perseus, Wanaea  
[www.woodside.com.au](http://www.woodside.com.au)

**PLATINUM**

**BHP Billiton (Nickel West)**

191 Great Eastern Highway  
Belmont WA 6104  
(08) 9479 0500  
Kambalda  
[www.bhpbilliton.com](http://www.bhpbilliton.com)

**SALT**

**Dampier Salt Pty Ltd**

37 Belmont Avenue  
Belmont WA 6104  
(08) 9270 9270  
Dampier, Lake MacLeod, Port Hedland  
[www.dampiersalt.com.au](http://www.dampiersalt.com.au)

**Onslow Salt Pty Ltd**

PO Box 23  
Onslow WA 6710  
(08) 9184 9000  
Onslow Salt  
[www.onslowsalt.com](http://www.onslowsalt.com)

**Shark Bay Salt Joint Venture**

Level 16, 2 The Esplanade  
Perth WA 6000  
(08) 9265 8000  
Useless Loop

**WA Salt Supply Ltd**

Cockburn Road  
Hamilton Hill WA 6163  
(08) 9430 5495  
Lake Deborah East, Pink Lake  
[www.wasalt.com.au](http://www.wasalt.com.au)

**SILICA-SILICA SAND**

**SILICA**

**Simcoa Operations Pty Ltd**

PO Box 1389  
Bunbury WA 6231  
(08) 9780 6666  
Dalaroo  
[www.simcoa.com.au](http://www.simcoa.com.au)

**SILICA SAND**

**Rocla Quarry Products**

180 Fauntleroy Avenue  
Kewdale WA 6105  
(08) 9475 2555  
Gnangarra  
[www.rocla.com.au](http://www.rocla.com.au)

**Kemerton Silica Sand Pty Ltd**

PO Box A283  
Australind WA 6233  
(08) 9720 0022  
[www.ksspl.com.au](http://www.ksspl.com.au)

**Austsand Pty Ltd**

PO Box 1373  
Albany WA 6330  
(08) 9846 1288  
Mindijup

**SPONGOLITE**

**Australian Diatomaceous Earth Pty Ltd**

GPO Box 4188,  
Sydney NSW 2001  
Woogenellup,  
[www.supersorb.com.au](http://www.supersorb.com.au)

**TALC**

**Luzenac Australia Pty Ltd**

Level 22 Central Park  
152-158 St Georges Terrace  
Perth WA 6000  
(08) 9327 2277  
Three Springs  
[www.luzenac.com](http://www.luzenac.com)

**Unimin Australia Ltd**

26 Tomlinson Road  
Welshpool WA 6106  
(08) 9362 1655  
Mt Seabrook  
[www.unimin.com.au](http://www.unimin.com.au)

**TIN-TANTALUM-LITHIUM**

**SPODUMENE**

**Sons of Gwalia Ltd**

Level 3, 30 The Esplanade  
Perth WA 6000  
(08) 9263 5555  
Greenbushes, Wodgina  
[www.sog.com.au](http://www.sog.com.au)

**TANTALITE-TIN**

**Sons of Gwalia Ltd**

Level 3, 30 The Esplanade  
Perth WA 6000  
(08) 9263 5555  
Greenbushes, Wodgina,  
[www.sog.com.au](http://www.sog.com.au)



## Abbreviations

A\$	Australian Dollar	km	kilometres
ABARE	Australian Bureau of Agricultural and Resource Economics	km <sup>2</sup>	square kilometres
ABS	Australian Bureau of Statistics	LME	London Metal Exchange
AFR	Australian Financial Review	Mbbl	thousand barrels of oil
ANZ	Australia and New Zealand bank	MMbbl	million barrels of oil
bbl	barrels of oil	Mct	million carats
Bcm	billion cubic metres	Moz	million ounces
BMR	Bureau of Mineral Resources	Mt	million tonnes
cons	concentrates	Mt/a	million tonnes per annum
CSO	Central Selling Organisation	n/a	not applicable
ct	carat	oz	ounce
DRI	Direct Reduced Iron	RBA	Reserve Bank of Australia
ECB	European Central Bank	t	tonnes
f.o.b.	free-on-board	t/a	tonnes per annum
f.o.t.	free-on-truck	Tcf	trillion cubic feet
GDP	Gross Domestic Product	US\$	United States Dollar
HBI	Hot Briquetted Iron	WTI	West Texas Intermediate
IMF	International Monetary Fund		

## Units and Conversion Factors

	Metric Unit	Symbol	Imperial Unit
Mass	1 gram	g	= 0.032151 troy (fine) ounce (oz)
	1 kilogram	kg	= 2.204624 pounds (lb)
	1 tonne	t	= 1.10231 United States short ton [1 US short ton = 2,000 lb]
	1 tonne	t	= 0.98421 United Kingdom long ton [1 UK long ton = 2,240 lb]
	1 tonne LNG	t	= 52,000,000 British Thermal Units (Btu)
Volume	1 kilolitre	kl	= 6.28981 barrels (bbl)
	1 cubic metre	m <sup>3</sup>	= 35.3147 cubic feet (ft <sup>3</sup> ) [1 kilolitre (kl) = 1 cubic metre (m <sup>3</sup> )]
Energy	1 kilojoule	kj	= 0.94781 British Thermal Units (Btu)
	Energy Content	Prefix	
Coal	19.7 GJ/t	kilo (k)	10 <sup>3</sup>
Condensate	32.0 MJ/L	mega (M)	10 <sup>6</sup>
Crude oil	37.0 MJ/L	giga (G)	10 <sup>9</sup>
LNG	25.0 MJ/L	tera (T)	10 <sup>12</sup>
Natural gas	38.2 MJ/m <sup>3</sup>	peta (P)	10 <sup>15</sup>
LPG-butane	28.7 MJ/L (1tonne LPG-butane = 1,720 litres)		
LPG-propane	25.4 MJ/L (1tonne LPG-propane = 1,960 litres)		

## Data Sources

Quantities and values for minerals and petroleum in this publication are collected from a variety of sources including:

The Department's royalty returns, various company annual reports and quarterly Australian Stock Exchange reports, State port authority statistics, the ABS and ABARE.

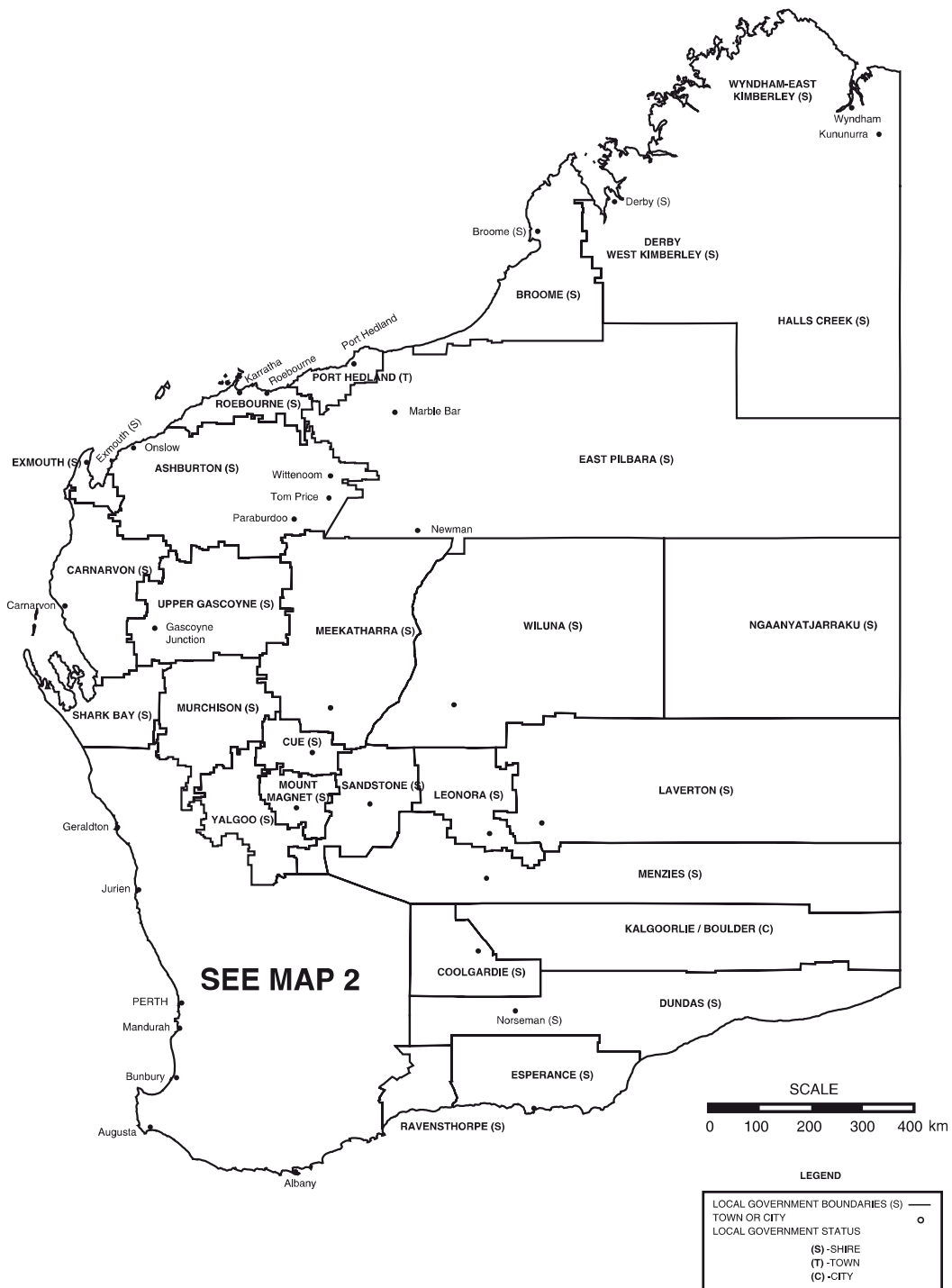
Quantities specified relate to either mine production or sales as listed below for each commodity.

Mine Production
Clays
Coal
Construction Materials
Dimension Stone
Gold
Gypsum
Limesand–Limestone–Dolomite
Silica–Silica Sand
Talc
Sales
Alumina
Base Metals (Copper, Lead and Zinc)
Chromite
Diamonds
Gem and Semi-Precious Stones
Heavy Mineral Sands
Industrial Pegmatite Minerals
Iron Ore
Manganese
Nickel Industry (Nickel, Cobalt, Platinum and Palladium)
Petroleum
Pigments
Salt
Silver
Spongolite
Tin–Tantalum–Lithium
Vanadium

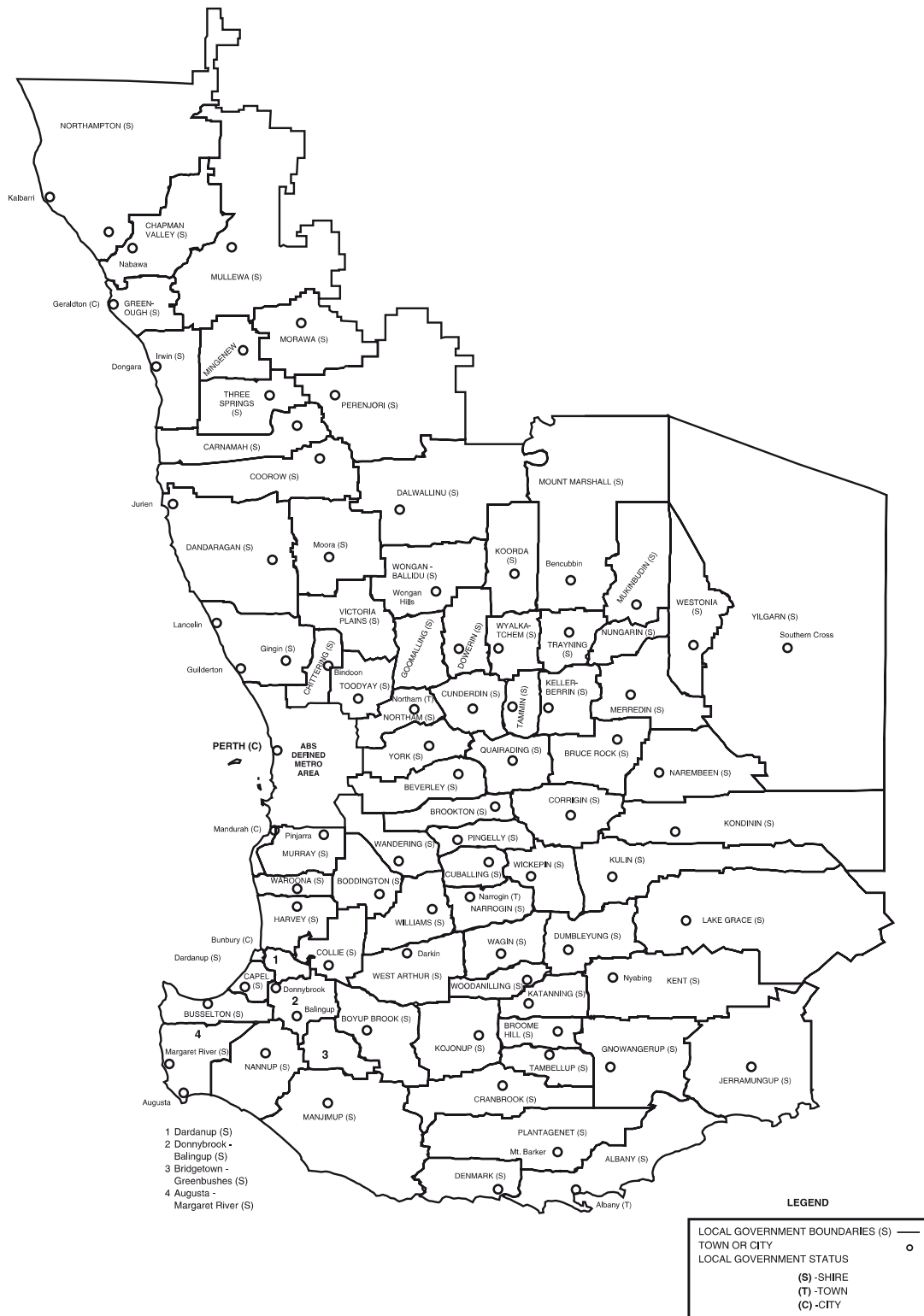
## Classification of Countries

Euro area <sup>1</sup> / European Union	
<i>Austria</i>	<i>Italy</i>
<i>Belgium</i>	Latvia
Cyprus	Lithuania
Czech Republic	<i>Luxembourg</i>
Denmark	Malta
Estonia	<i>Netherlands</i>
<i>Finland</i>	Poland
<i>France</i>	<i>Portugal</i>
<i>Germany</i>	Slovakia
<i>Greece</i>	Slovenia
Hungary	<i>Spain</i>
<i>Ireland</i>	Sweden
	United Kingdom
Non-Japan Asia	
Afghanistan	Myanmar
Bangladesh	Nepal
Bhutan	Newly industrialised Asia
Brunei Darussalam	Pakistan
Cambodia	Papua New Guinea
China	Philippines
Fiji	Samoa
India	Solomon Islands
Indonesia	Sri Lanka
Kiribati	Thailand
Lao PD Republic	Tonga
Malaysia	Vanuatu
Maldives	Vietnam
Mongolia	
Newly Industrialised Asia	
Hong Kong	Singapore
Republic of Korea	Taiwan

<sup>1</sup>Italics indicate countries that are members of the euro area.

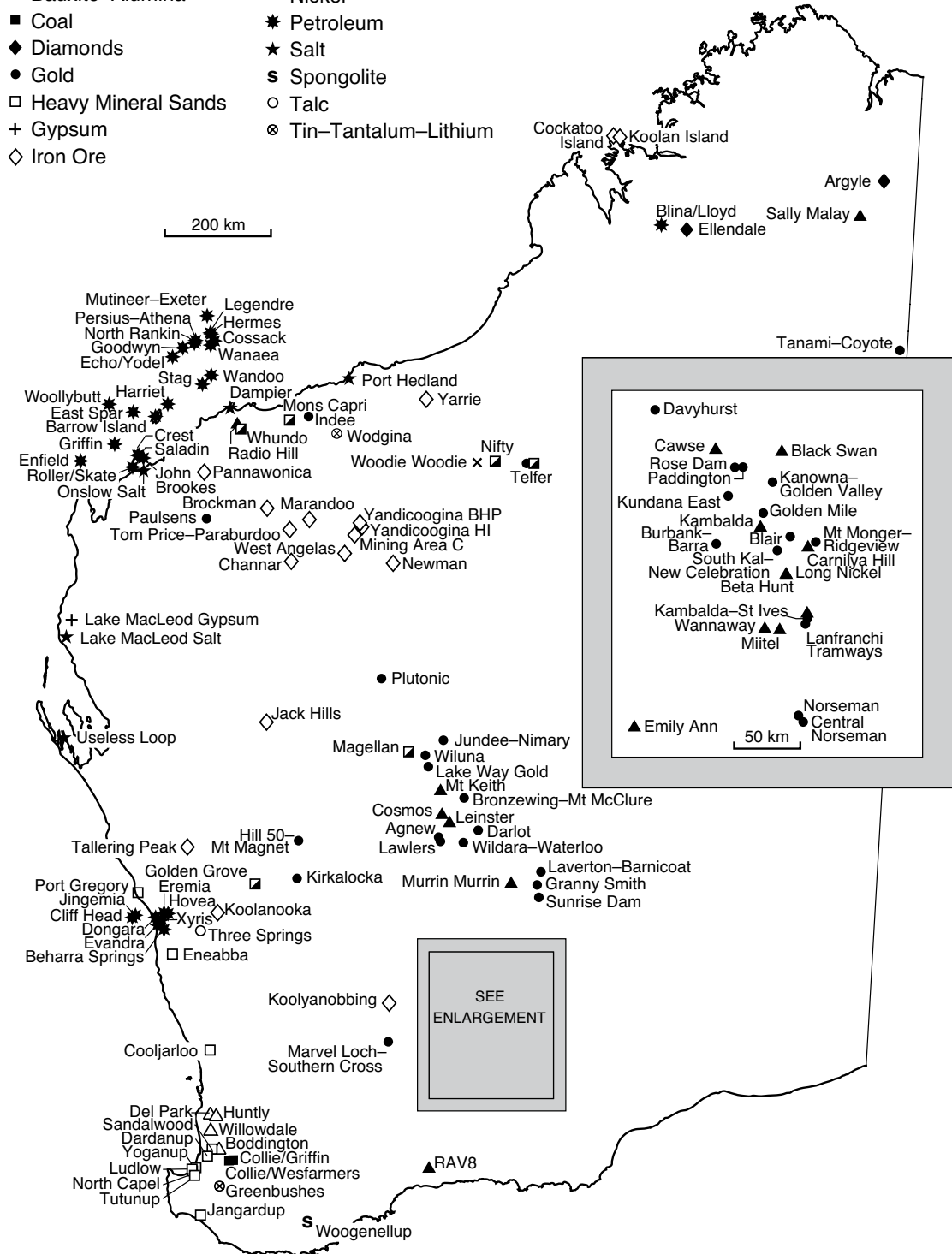


**Map 1 Local Government Boundaries**



Map 2 Local Government Boundaries

- ▣ Base metals
- △ Bauxite–Alumina
- Coal
- ◆ Diamonds
- Gold
- Heavy Mineral Sands
- + Gypsum
- ◇ Iron Ore
- × Manganese
- ▲ Nickel
- ★ Petroleum
- ★ Salt
- Ⓢ Spongolite
- Talc
- ⊗ Tin–Tantalum–Lithium



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**Map 3 Major Mineral and Petroleum Projects in Western Australia**



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